THE

ELECTRICAL REVIEW.

VOL. XLIV. JUNE 30, 1899. No. 1,127.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

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ENGINEERS MUST STANDARDIZE.

NOT so long ago it was the unanimous practice to scoff at the mere suggestion that our position as a manufacturing nation was in danger of being seriously assailed, and almost everyone would insist upon looking exclusively at the bright side of our national industries, and upon entirely ignoring the shady side. While now that this side has admittedly been gradually, but steadily increasing its area for many years past, numbers of more or less plausible explanations have been advanced for this increase in the area of the shady side of our national industries—first, the trades unions have been blamed, and anon the masters, now it is free trade that has become an anachronism, and then it is the lack of interest displayed by the Foreign Office. All these and other factors have, no doubt, contributed their quota to a result which all recognise more or less, and recognising deplore. To what extent each of these factors has contributed it is beyond our present purpose to inquire. We would, however, point out that the steadily increasing and successful competition, which the United States is carrying against our home products in all branches of engineering, is largely due to the difference between the attitude assumed by the engineering profession towards the manufacturer of engineering products on this side of the Atlantic, as compared with the attitude of the profession on the other side. American engineers have long since tacitly subscribed to what might be termed a self-denying ordinance in respect to designing. They have recognised that the general practitioner, though doubtless fully qualified to design a bridge or an engine or a dynamo, can never hope to do as well as an engineer who dedicates his whole time to the preparation of designs for these specialities. The manufacturer makes it his business to attach these specialists to himself, while the general practitioner in engineering avails himself invariably of their services. The designer being thus at one with the manufacturer, there is no risk of the scientific specialist being led into unreasonable cost by following out special fads in design. Trade sections and sizes invariably are used, and the expense reduced to bed rock level. The manufacturer is enabled to standardise everything he manufactures; he can, therefore, add to stock, and keep his works running whenever orders slacken. He can afford to have all his patterns and templates made of metal instead of wood, with the double advantage of considerable saving in ultimate cost, and of positive assurance that the parts will always fit, no matter what the temperature at which they are manufactured. Manufacturing has thus been rendered more and more automatic, labour saving, and inexpensive. All that an engineer need do when he wants a roof truss, a boiler or generator, is to specify the conditions he requires them to comply with when erected, the limiting dimensions they must possess, and he can confidently leave the rest to the manufacturer

C

and his staff of specialists. In ninety-nine cases out of a hundred the order can be supplied out of stock, or, at least, from stock designs, whose constituent parts are kept ready at hand. This system extends down to the smallest items and fittings throughout the field of manufacturing engineering. The practice of standardising enables the manufacturer to study economy on every hand, to improve his system of manufacturing, his machinery, and his methods down to the minutest details. There is no leakage through having to provide for new details and unfamiliar conditions; everything is reduced to the footing of routine. How different is the case on our side! Engineers as a profession have never considered the interests of the manufacturer in the slightest degree, and, forsooth, because they know the principles of the design of a plate girder or a traction engine or a switchboard, they seem to fancy that it is incumbent upon them to prove their knowledge by designing them, and, as a consequence, no two designs are the same in details, and the patterns that have to be prepared for manufacturing these designs are all different, nothing can be stocked, not even the most usual sections, for the odds are strongly against their being adopted.

When a manufacturer has to carry out an order, he almost invariably finds that nothing worth mentioning which his works contain can be adapted. He has to start from first principles, from the lowest rung of the manufacturing ladder; he has to multiply hand labour, and such machinery as he possesses avail him but little. It is not at all improbable that the relative inferiority of the equipment of our engineering works, as compared with similar works abroad, especially in automatic machinery, is largely due to the above circumstances.

But enough of a painful homily; the remedy is in the hands of our scientific institutions. Their duty is comparatively obvious; they should, on national grounds, in the interests of our manufacturing position among nations, call upon their members to agree upon standards of design and specification in each branch of engineering, and carry these standards right down to the smallest details, and finally agree to hand over the work of design, in all save exceptional cases, to the manufacturers. We have no doubt that, great as the leeway undoubtedly is, it could and would be quickly made up, provided manufacturers here were given the same free hand that they habitually receive in the States. Possibly the engineering orders which have of late been so lavishly bestowed on the other side of the Atlantic may prove a blessing in disguise, in that they may teach our engineering profession that manufacturers who prepare their own specifications and designs can turn out work if not superior to that of their rivals who are not allowed to do this, at the very least of equal excellence.

Perhaps before very long in electrical matters, we may not have our patriotic feelings so constantly affronted as we do now, by the invariable answer "Made in America," which is given to almost every inquiry as to the origin of one of the thousand and one appliances and fittings which are required in this branch of engineering, if such a happy result as we have sketched above should take place.

What more extensive or lucrative field could our manufacturing engineers wish for, than that of the accessories of electric traction? But how few, and how comparatively inferior, are the accessories that are actually manufactured in this country! Yet electric traction has just caught on to the public idea; we are on the threshold of enormous developments in this direction. Our tramways will all have to be converted within the next few years; our light railways will most of them be built on this system for the future, and our suburban and metropolitan lines will all have to be converted also. Are the enormous sums that must be spent in the appliances required for these vast undertakings to go to foreign manufacturers? It looks like it, unless some half dozen first class works are very shortly established and equipped with the necessary tools and patterns to turn these appliances out, on a scale comparable with those in the States. Let our electrical engineers see to it that these works are no more hampered by the profession than are those of their American competitors; in other words, that no individual practitioner's ideas or designs are made compulsory in tenders, or obligatory on the manufacturers. And let our manufacturers see to it that they do not waste time and money in experimenting in designs, and going over the same ground that their American *confrères* have already trodden. Let them be content to copy at the start, and wait for the accumulation of personal experience before they attempt to originate. In this way they can secure the full advantage of the capital which others have sunk to attain these results, and avoid sinking their own till they can improve upon what they have started by copying.

Recalescence.—We have received from Prof. W. F. Barrett, the Royal College of Science, Dublin, a note on his claim to be the first discoverer of the phenomenon of recalescence. It is occasioned by a recent reference to the matter by Sir W. Roberts Austen in his presidential address to the Iron and Steel Institute, in which he stated that—"To Gore and to Barrett we owe the investigation of the nature of a fact which had long been well known to smiths, that iron on cooling from a bright red heat suddenly emits a glow." Prof. Barrett quotes a letter from Dr. Gore himself, dated December 2nd, 1873, and another from M. Osmond, dated December 13th, 1889, both of which expressly attribute the credit of the discovery to him. It seems that Dr. Gore had observed in 1869 one of the phenomena attending the passage of iron through the recalescent temperature, and another was referred to in a paper by him in the *Phil. Mag.* in September, 1870; but Prof. Barrett was the first to examine the matter closely, to describe exactly what occurs, and to propose the name recalescence. The phenomenon is so conspicuous when once it has been pointed out, that it is incredible that no individual of the many generations of smiths who have worked iron ever observed it; but this does not constitute "discovery" in the accepted sense.

New Pump Valve.—In pumps of the pulsating variety it is necessary that the steam inlet valve should be particularly delicate and certain in its action. In the pulsating pump of Messrs. Holden & Brooke, of Manchester, a new form of valve has been introduced. In cross-section it is like an inverted U, thus: ∩, the valve faces, two in number, being upon the two outer sides. This valve is supported upon a central pivot rounded at both ends, and it is free to place itself against either of its seatings, which form the entrances to the two water bottles, a very slight movement places the valve on one or other of the seatings, and the system of free support enables the valve to absolutely and truly seat itself, even if the seatings are not truly parallel. The alternating vacuum and steam pressure in the two water bottles form, of course, the moving power to shift the valve over from side to side. The same firm has also brought out a new combination exhaust and live steam injector, which they claim to be capable of feeding at a temperature of 235° to 270° F. and against 200 lbs. pressure.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 925.)

Fig. 44 (A, B, C, D) gives the mechanical details of a motor compressor. Nos. 6-6 are the interchangeable suction and discharge valves accessible by removing cap No. 7. The pistons (No. 8) are provided with packing rings (No. 10), and wrist pins (No. 9), attached to the connecting rods (No. 17) and with bronze bushings (No. 19) for the crank wrist pins which are of tempered steel. They are covered by caps (No. 18) bolted together by cottered pins (Nos. 20 and 21). These caps have thin liners (No. 22) for taking up wear and tear. The crankshaft (No. 13) is mounted on main bearings A and B, with caps (No. 2-2) fastened with studs and cotter keys (No. 3). The gearing (No. 23) is secured to crankshaft by cottered key nut and washer (No. 16-15-14) and covered by a case (No. 24), fastened by cap screws (No. 78), which is made tight with pump casing (No. 1) by a gasket (No. 25). The cylinder head (No. 9) contains the suction and discharge valves, these are provided with strainers (No. 97). The motor base (No. 27) forms the top cover of the pump casing. The field frame (No. 37) fastens directly to the pump casing. The armature (No. 39A) is mounted on oil ring bearings, and is provided with an oil guard (No. 91) to protect the winding. The bushing (No. 57) has a stuffing box with gland and caps (60-58-59). Here the main chamber A is partly filled with oil through aperture B, whose height gauges the oil. The ring oiler causes the oil to pass through the bearing-bushings into chamber C, from which it drains back into A, whence any excess passes into D, and by an overflow connection back to the pump casing. On the armature shaft is mounted the driving pinion (No. 47).

The table which follows gives all the leading dimensions of the motor compressors usually constructed, which constitute a range covering all possible requirements of electric car service; No. A-1 being of sufficient capacity for one motor car, and No. D-4 for a train of 50 cars.

Motor Compressors.—550 Volts.

Comp. No. or type.	Cylinder size.	Cubic feet per minute.	H.P. at 90 lbs.	Armature speed.	Gear speed.	No. of teeth.		Ratio.	Dimensions.			Dia. of armature.	Centre distance between gear and piston.	Amp.	Weight.
						Gear.	Pinion.		Length.	Width.	Height.				
A—1	5 × 2½	10	2	1,350	175	108	14	7·7	21¼	18⅞	18	6	6⅜	3·9	406
AA—1	5 × 2½	11	2·2	1,350	193	98	14	7	21 3/16	18 5/16	17 9/32	6	6 7/32	4·3	406
B—2	6½ × 3	20	4	1,100	172	96	15	6·4	28 1/16	21 9/32	21⅜	7½	7 9/32	6·5	725
C—3	7½ × 4	35	7	1,150	172	107	16	6·6	32¼	24½	23 7/16	8	8 9/32	11·2	950
D—4	8½ × 4	47·6	9·5	1,100	182	115	19	6	35 7/16	25	25⅛	8¼	9 7/32	15·5	1,118

The governor or controller is adjusted to cut out the current at any desired pressure. The switch controlling the current is worked from two small cylinders, one communicating directly with the reservoir through a double-acting spring loaded valve, the other with the exhaust through a similar valve, and *vice versâ*. When the pressure in the reservoir reaches the maximum, one valve is opened to the reservoir and pressure admitted into one cylinder, while the opposite cylinder is placed in communication with the exhaust. The switch is moved and cuts out the current. When the pressure falls to the minimum, the reverse takes place and the current is cut in and closes the exhaust while opening the suction, and the compressor once more comes into action and works till the pressure in the reservoir again reaches the maximum.

Motor compressors are fitted with equal facility to motor-cars with one trailer and to trains worked on the Sprague multi-unit system where all the independent motor compressors are controlled from the automatic controller in the front car, and the pressure in each compressor and main reservoir is equalised by the engineer valve previously described.

The essential feature of the multiple-unit system of control is the equipment of each car with a complete air brake outfit including compressor, main reservoir, and auto-governor. These and the subsidiary parts are arranged and connected in the way shown in fig. 45. The trolley is connected with a cut-out switch placed under the canopy. Between this switch and the compressor is placed a fuse connected to one terminal of the latter, the other terminal being connected with the auto-regulator, this being in turn connected with the ground wiring. As an alternative the auto-regulator can be placed between the trolley cut-out switch and the regulator (as shown in the figure). The auto-regulator consisting of one cylinder, opens or closes the circuit automatically by the air pressure in such a manner that when this is low the circuit is closed and the compressor pumps air into the main reservoir till the maximum pressure is reached, the circuit is then opened by the auto-regulator and the compressor stopped. The auto-regulator is worked by pressure from the main reservoir and connected thereto with piping fitted with a cut-out cock near the governor, this being closed in case the latter is out of order. When this is the case, the switch under the canopy and that between the balancing wire and the auto-regulator have both to be opened. The main reservoir is connected by piping to the two engineer valves at each end of the car, these latter being themselves connected in the same way with the triple valve which operates precisely as the corresponding valve does in a train worked by steam. Each engineer valve has a cut-out cock above the platform for main reservoir and train pipe. All these cocks are kept constantly closed, except those operating the brakes on the engineer valve.

The conditions subject to which a train of cars equipped as above must be worked, are the following:—

1. The stopping and starting of all compressors should absolutely synchronise. This is effected by having a "balancing" wire throughout the whole length of the train connecting each compressor to each governor on each car. With this arrangement and all canopy switches closed, the compressors continue working till the last governor cuts out, and all compressors can be governed by one canopy switch and one governor on any one car. To cut out any one compressor, it is only necessary for the canopy switch on the particular car in question to be opened as well as the small switches near the auto-controller, this being done when the compressors are not working, and the effect is that the compressor on this one car only, is cut out.

The balancing wire is made up in the same cable with the pilot motor wires.

2. The pressure in all main reservoirs should be absolutely equal. This is effected by having a special pipe line with a cut-out cock at the end of each car, and special connections throughout the whole length of the train. In case of accident to the insulation coupling or the piping between a reservoir and a compressor, a check or non-return valve fixed to the opposite end of the reservoir prevents wasting of air from other reservoirs.

3. The train pipe should be arranged precisely as in the regular automatic air brake system, extending through the whole length of the train, with branches provided with cut-out cocks to each triple valve and engineer valve, the cut-out cocks being placed in the vestibule, and also with the stop cocks close to the hose coupling at each end of the car. In case of accident to a triple valve the cut-out cock is closed and the auxiliary reservoir is "bled" by opening its drain cock. All duplicate engineer valve cut-out cocks are closed for main reservoir and train pipe except those in actual use.

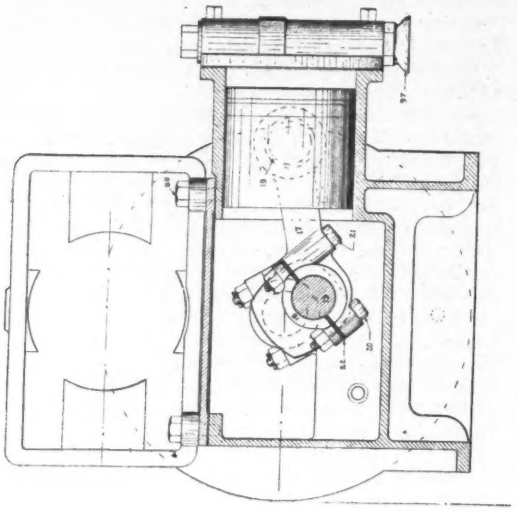


FIG. 44D.

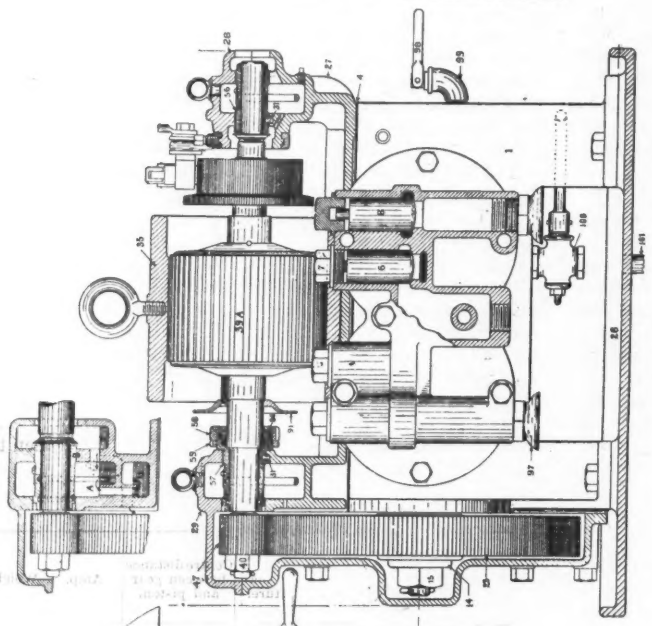


FIG. 44B.

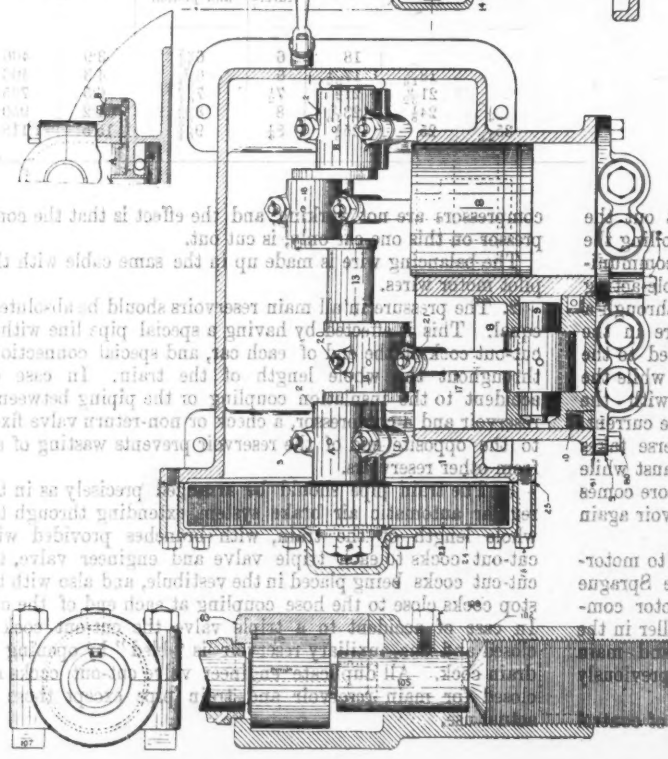


FIG. 44A.

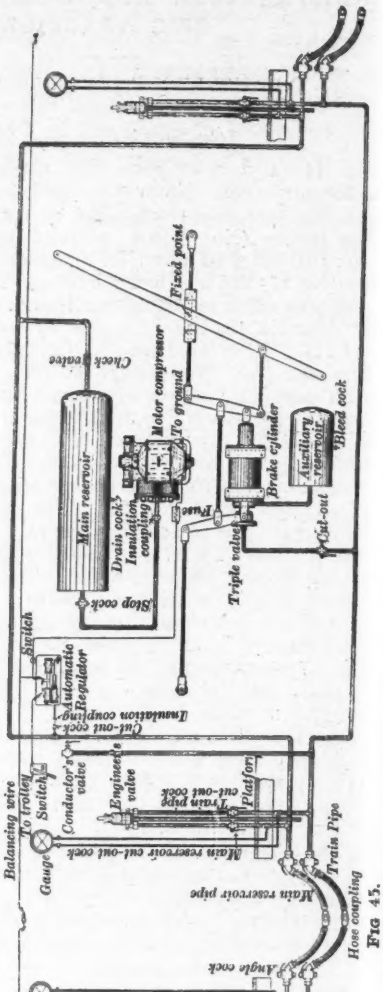


FIG. 45.

FIG. 46.

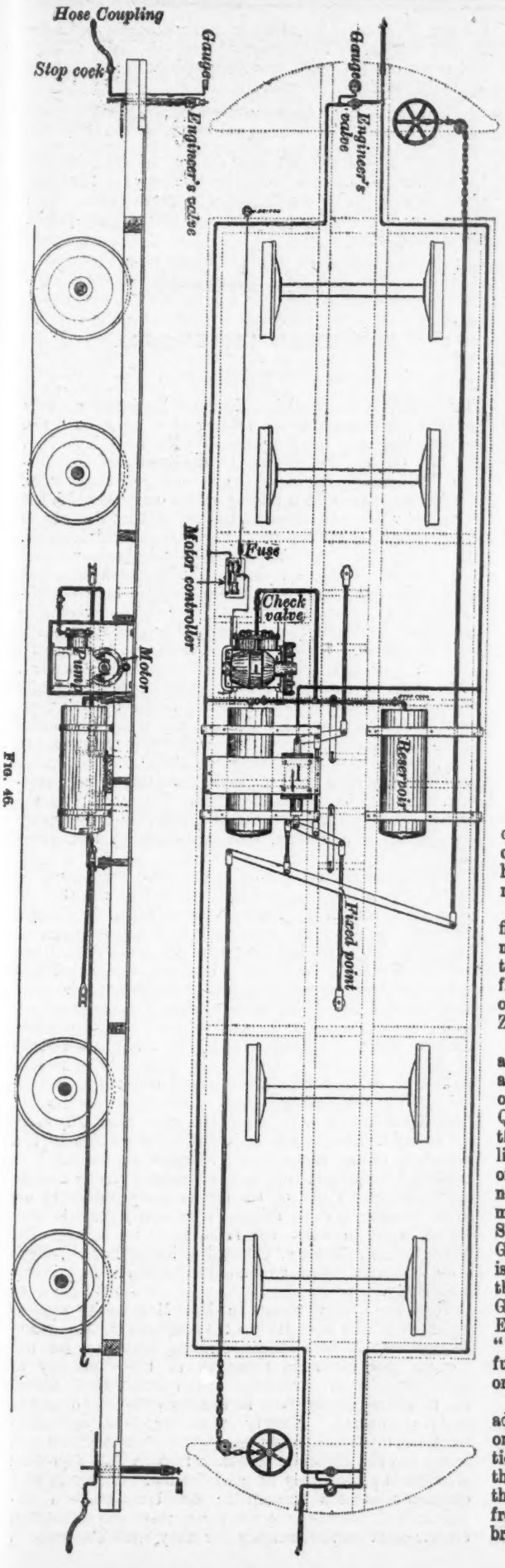


Fig. 46.

Fig. 46 shows the latest arrangement by which the motor compressors are slung underneath the car body, this contributes considerably to their noiseless working and affords better space for the location of the various parts than that below the car seats.

The time required to stop with air brakes from the instant of application of the brakes as compared with mechanical brakes is reduced to one-third. The adoption of air brakes has therefore considerably diminished the number of collisions on the lines using them, the reduction amounting to something like 75 per cent.

As the majority of accidents occur during the last two-thirds of the time expended in stopping by hand brake, the protection afforded by the use of air brakes against injury or loss of life to pedestrians is most important. The advantage afforded by their use in the keeping to schedule time in running is quite as remarkable. This is entirely due to the increased confidence induced in the motorman by his instant and absolute control over the running, independent of personal strength or skill.

Lastly, the effect on the life of the brake blocks is also remarkable, amounting to an increase of some 200 to 400 per cent. Here, again, the motorman being sure of his control does not so often or so indiscriminately apply the brakes, and hence their wear and tear is diminished.

(To be continued.)

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 1014.)

II.—What Route should be Selected for the Cable?

In the instrument of appointment of the Committee this question is made to be dependent on the technical possibility of laying the cable, which, as will be gathered from what we have written above, is admitted by all the witnesses to be a matter of no exceptional difficulty.

When asking for tenders the Canadian Government specified eight distinct routes as alternatives, but almost by common consent of those interested and consulted, it has seemed that to meet all the requirements the cable should be laid from Vancouver to Fanning Island, from thence to Fiji, and on to Norfolk Island, whence it should bifurcate to New Zealand and to Australia.

As Mr. W. P. Reeves points out, this route was advocated at the Sydney Conference, where it was agreed to unanimously, as being to some extent a compromise between the conflicting opinions held by the representatives of New Zealand and Queensland. It was also pointed out by Sir Sandford Fleming that it was the only route where a cable could be established with advantage, cut off as we were from the possibility of obtaining a landing on the Hawaiian Islands (which had not then been annexed by America), owing to a treaty agreement between the Governments of Hawaii and of the United States, and also owing to the dilatoriness of Her Majesty's Government in securing one of the outlying uninhabited islands near the Hawaiian group. This delay permitted of this island being formally taken possession of by the Hawaiian Government while the matter was under discussion in England. As Admiral Wharton pointed out in his evidence, "there is very little choice" as to the route which would fulfil the necessary condition of touching on British territory only.

It was pointed out by Mr. A. Siemens that it was of course advantageous on the score of economy to select a route with only comparatively small spans, but this, under the conditions, cannot be found. In his evidence, Mr. Playford said that he thought it was a mistake, a costly mistake, to carry the cable from Norfolk Island to New Zealand, as well as from that island to Australia. Now, as the length of the branch to New Zealand would be only 537 miles of a cable

with a small core, costing about £53,000, the cost is comparatively slight, especially in view of the advantages to be gained.

Had Mr. Playford studied the charts, he would have seen that about half way between New Zealand and Australia there is a submarine ridge, running approximately N.N.W. from Lord Howe Island, and including the Chesterfield Reef, besides several small reefs and shallow coral patches, which lie between these places. This ridge is about 1,000 miles long and about 120 miles wide, and the water over it has a depth of about 700 fathoms, while on the Australian side of it the depth varies between 2,500 and 3,000 fathoms. On the New Zealand side the depth ranges from 1,500 to 1,900 fathoms. Indications of this danger are to be found in Sir Sandford Fleming's evidence. It is true that the cables which were laid between New Zealand and Australia in 1876 and 1890 have lasted well, the same is the case with the cable laid by a French company between New Caledonia and Australia in 1893, although all three cables are laid across this ridge. This is, we think, the worst part of the proposed line through the Pacific, and it is only a reasonable precaution, and not a costly one, to run a branch cable from Norfolk Island to New Zealand, which would be clear of the ridge, and thus, in case the Norfolk Island-Australia cable breaks down we would be assured of continuity between Canada and New Zealand, and also in case of need be able to maintain communication with Australia by the existing lines.

In examining Mr. Lucas, Lord Selborne said :—"Now the Telegraph Construction and Maintenance Company, which you represent, criticised the proposals rather freely, the chairman—Sir George Henry Richards that would be, I suppose? (Mr. Lucas: Yes.) He objected to the conditions, and he objected also to the routes offered for consideration. Can you tell the Committee what it was in the proposals and route that Sir George Henry Richards mainly objected to?" Mr. Lucas, replying, said :—"He held very decided views upon that subject. In the first place, he was very strongly of opinion that the route should be the trade route, that the cable should go where the steamers call, that it should be laid in as short sections as the Pacific Ocean would allow. Then he was of opinion that for a cable to land on an island which is British was really very unimportant." The reference to the unimportance of the landing place being British was made more particularly in relation to the cutting of cables.

In Appendix B, which is a report on the tenders handed in, it will be found that the chairman of the Telegraph Construction and Maintenance Company objected to each of the eight routes specified, and proposed a new route taking in Honolulu and Samoa. In view of the treaty between the Hawaiian and American Governments above referred to, it is obvious that this route was an impossible one. The Marquis of Tweeddale, who was examined at the same time as Mr. H. A. Saunders and Mr. F. E. Hesse, expressed an opinion almost identical with that of Sir George H. Richards, and named the same islands as above mentioned, as landing places. In expressing disapproval of the proposed route, the gentlemen under examination pointed out that it was very deep water, and that there was almost always bad weather. The Marquis of Tweeddale said that the company which he represented "would be quite ready to negotiate for the laying of a Pacific cable on our own account, if we could select our own landing places, and the question of tariff was placed on a reasonable basis." He, however, took exception to the Vancouver-Fanning Island section, which his company could only use their best endeavours to maintain, and charging the Government with the cost of maintenance. Sir W. H. Preece also proposed two new routes, the first from Vancouver Island to Fanning Island, Canton Island, Fiji and New Zealand; the second was similar to the above, but included Honolulu (between Vancouver and Fanning Islands). These routes, inasmuch as one of them includes the impossible Honolulu, and both exclude Norfolk Island, which was unanimously agreed to at the Sydney Conference, may be disregarded. It is, perhaps, worthy of note here that the overground distance between Vancouver Island and Fanning Island given by Mr. Preece with 10 per cent. slack included, is 2,628 nautical miles, while that put in by Mr. Lucas is 3,650, which is, in the case of the former, 86 miles, and in the case of the latter, 108 miles more than is given by Admiral Wharton, an unquestionable authority on this subject. The importance of this extra mileage in diminishing the speed of a long cable we will deal with under the heading of revenue.

(*To be continued.*)

[ERRATUM.—In our last issue the core of the cable laid for the Anglo-American Telegraph Company in 1894 was given as 450 lbs. of copper and 400 gutta-percha. This should be *650 lbs.* of copper and 400 lbs. of gutta-percha per nautical mile.]

MUNICIPAL TELEPHONES.

THE meeting of the Municipal Electrical Engineers was very appropriately chosen for the reading of a paper on "The Municipalisation of the Telephone," by Mr. A. B. Mountain, M.I.E.E., the electrical engineer for the Borough of Huddersfield. We publish the paper *in extenso* in another column. Mr. Mountain feels he is dealing with a question which has lately received careful consideration, but without leading to that unanimity of opinion which may be considered desirable. In his summary of the efforts aimed at telephonic progress and the causes of their ill success, Mr. Mountain says that the high charges for exchange rentals have led to the introduction of an immense number of private lines of very little general use, which would not have been erected if exchange rates were lower. Without the information at the author's disposal, it is somewhat difficult to credit this statement. There must obviously be some such cases, but that their number is immense is open to doubt. Under the telegraph regulations a private line which has not both ends terminating on premises of the same occupier, pays royalty to the State, and can only be erected by the Post Office, or one of its licensees. When such a line is under the same ownership, there may be motives of economy, but more often the private line is adopted because of its greater utility under the special circumstances, than an exchange line would offer.

Mr. Mountain gives reasons why the telephone should be in the hands of the local authority rather than the Government or a company. Nationalisation would, he thinks, represent stagnation, as there would be no competition, no local control, and no inducement for the local authority to assist in developing the system. It should be remarked that the competition referred to is not competition in the same area, but "the healthy competition between the various local authorities which has led to the rapid advance of electricity undertakings." The main point Mr. Mountain is anxious to emphasise is the urgent need of development. He contrasts an area of 150,000 population having 600 telephone subscribers, very few residences being connected, with a pleasant spot on the Geneva Lake, where he found practically every one of any importance was connected to the telephone. Mr. Mountain thinks many local authorities are hesitating at municipal telephones, fearing the financial results may be unsatisfactory. Many of the figures lately considered are so at variance that he thinks it extremely difficult even for an expert to select the right from the wrong. Mr. Mountain has, therefore, prepared estimates himself, which show that even with a £5 rental the result will be perfectly satisfactory.

There are many points in Mr. Mountain's paper to which those who have studied the telephone question would be inclined to take exception; but supposing for one moment that his main thesis as to the suitability of municipalities to undertake the service were agreed to, it seems to us that it can only be so considered in the abstract. Twenty years ago the arguments favouring municipal telephones might have been put forward in the way Mr. Mountain puts them forward. As a question of practical politics they have no bearing. It is not now a question whether a municipality should undertake a telephonic service in the same manner as they have undertaken electric light service, but whether they shall undertake a

telephone service in opposition to, and in competition with, an already established private service.

Regarding the paper, however, from the practical point of view, let us consider how far Mr. Mountain enlightens his fellow municipal engineers and gives them some definite data in place of the uncertainty which he admits to be general. His estimate of cost is entirely lacking in elements for discussion. So many lines so much outlay. It works out at £20 per line. It may be right, but where is the data? The author states that he has carefully consulted existing records, and points out that in nearly all cases where the capital outlay exceeds £20 per subscriber the cost has been increased by reconstruction and preliminary investigations, which are not now necessary. At the close of his paper Mr. Mountain has appended a very useful tabulated statement from the report presented to Parliament respecting the telephone service in various foreign countries. The capital outlay is given in the case of 13 towns and the average is £23 12s. 6d per subscriber. The majority are single or part single and part double lines. The exchanges, which are exclusively metallic circuit (one of the necessary conditions laid down by Mr. Mountain) number three, and the average capital cost per subscriber is £32 16s. 6d. There are only two exchanges controlled by municipalities, and both are in Holland. The capital outlay in one is £33 6s. 8d., in the other £45, giving an average of £39 3s. 4d. per subscriber, or within a fraction of 100 per cent. above the amount allowed by Mr. Mountain. These exchanges have certainly not been re-constructed, but there may be some circumstances unknown to us which will demonstrate that it is more expensive for a Dutch municipality to instal telephones than it would be for an English municipality. Mr. Mountain could doubtless explain it; but in the meantime we are bound to confess that his estimate seems to us to be just about as much guess work as its predecessors.

The telephone service of Montreaux, to which Mr. Mountain refers, is a tribute not to municipal telephones but to State telephones. The service in Switzerland, which is commended on all hands for its extensiveness, its low cost, and its general efficiency, is what it is, not as the result of any municipal help, but because of the unity of control which makes it possible to communicate throughout the State on terms that come well within the views of the thrifty Switzer. We cannot say what would happen if the telephone service of Switzerland were divided up so that each town or even each canton had its own service, its own rules and its own management all pursued with that friendly rivalry which has for its object the demonstration of somebody's superior economy by a fourth decimal, and for its result the increase of difficulties in communicating with other towns or cantons.

In case the capital expenditure should happen to be 100 per cent. more than estimated, there would, of course, be some changes necessary in the revenue accounts, leading either to an adverse balance, or an increase in the subscription rate. But apart from this it may be asked whether the 6,000 subscribers are all to be connected up at once, whether all are to send their full complement of calls at once. Will there not be a period of expenditure in full with a revenue only in part?

There are many points in connection with the telephone service to which municipalities are giving—as they require—very serious consideration. In regard to the cost it is important that they should not be misled. In embarking on any new enterprise the expenditure on which cannot be accurately gauged, it is invariably the wiser plan to take an outside estimate rather than count upon getting through with a less cost than any experience shows to be possible. It is for that reason that we have taken up some of the points in Mr. Mountain's paper with a view to prevent possible disappointment hereafter.

Designs Wanted.—The St. Martin's-in-the-Fields Vestry, London, wants designs for electric lamp standards and brackets. A premium of £10 is offered for the most suitable design, and £5 for the second. Particulars from the Vestry Surveyor, Mr. George Green, at the Town Hall.

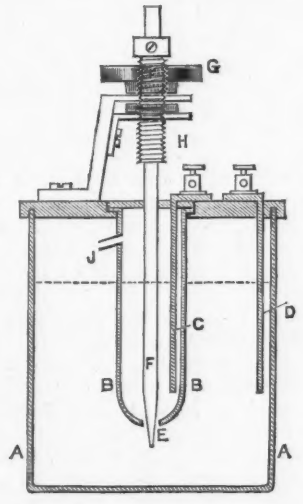
ROYAL SOCIETY CONVERSAZIONE.

The number of exhibits connected with electricity at the Royal Society conversazione on 21st inst. were few, but they were mostly of very considerable interest and originality.

Mr. Mackenzie Davidson's stereoscopic apparatus for Röntgen screen images marks a further considerable advance in the field where he has already done so much good work. His previous apparatus for localising foreign bodies have aimed at determining the co-ordinates of the body by means of photographs, and this had obviously the disadvantage that careful measurement and setting out of the results were necessary before the exact position of the foreign body could be indicated to the surgeon. For military field surgery there is the further objection to the photographic method, that it involves the transport of considerable quantities of photographic material. Mr. Davidson in his new apparatus seeks to dispense altogether with photography, and to make use of the screen images only. He makes use of a principle which has already been used in the production of stereoscopic images by the magic lantern. By means of two X ray lamps instantaneous images, stereoscopically related, are thrown in rapid succession on a phosphorescent screen. These images are looked at through a rotating disc shutter, so arranged that one eye sees only one series of images, and the other eye the other series of images. On the axis of the shutter disc are two eccentrics set at an angle of 180°, which actuate the mercury contact breakers of the two induction coils which excite the two X ray lamps. The whole arrangement is driven by an electromotor on the axis of the disc. The speed must be sufficient to ensure continuous images. The images seen by this apparatus appear solid, and foreign bodies are seen in their true position. If this apparatus can be applied directly in surgery, the improvement on the older methods is obvious.

Mr. Swan exhibited a modified Wehnelt-Caldwell interrupter. This consisted of two lead electrodes in dilute sulphuric acid separated by a non-porous diaphragm of porcelain pierced with small holes of equal size. A pressure of 100 volts was used in working the coil with this break in circuit with the primary.

Mr. Campbell Swinton also showed a modification of the Caldwell interrupter. The area of the opening in the glass diaphragm is made adjustable, and the frequency thereby easily controlled. The annexed figure shows the construction of the Swinton break. The two electrodes of sheet lead, C



and D, dip into dilute sulphuric acid contained in the glass vessel A. The electrodes are separated by a hollow glass cylinder B, which surrounds the electrode C. In the bottom of this cylinder is a valve, E, consisting of a circular aperture about 3 or 4 mm. in diameter, which can remain full open, or be closed to any desired extent by the conical end of the glass rod F. This rod is carried by the screwed tube H which passes through the milled nut G, by turning which the

valve can be opened or shut to any desired extent. The overflow, J, is to allow the surplus liquid in the cylinder, B, to pass off when, as is found to occur in practice, the level in the cylinder rises. This interrupter has the advantage over the Wehnelt, that it does not suffer from fatigue, and works better with alternating currents.

Mrs. Ayrton showed some very striking experiments to illustrate her theory that the hissing of the electric arc is due to the contact of air with the crater.

Mr. J. E. Petavel exhibited an apparatus, which is the outcome of three years' research, and by means of which the molten platinum standard of light can be readily and effectively utilised. This standard, proposed by Violle in 1881, is admitted to be the most constant available, though hitherto the experimental difficulties have prevented its general adoption.

Light being now considered a mode of electricity, a remarkable invention in photography by Prof. Wood, of Wisconsin, may be looked upon as coming within the field of electrical interest. Prof. Wood, by the application of purely scientific methods, appears to have at length solved the problem of photography in natural colours. Negatives of the three primary colours are taken, as in the Ives' process; but in printing from these negatives, a diffraction grating, with a definite spacing for each colour, is superimposed on the negative. The printing from all three negatives is combined to produce a single positive transparency. When this transparency is viewed through a slit at the focus of the lens which concentrates the light, the object is seen in its true natural colours, which far surpass in brilliancy anything hitherto produced. Obviously these colour photographs can be multiplied by the ordinary process of contact printing.

THE INSTALLATION OF STEAM BOILERS.

III.

In the construction of a boiler there are five mechanical operations to which attention may be drawn, namely, punching, drilling, drifting, planing, and riveting. The first is obsolete. A good sharp punch with a clean edged bolster does not, perhaps, much damage a plate, but a punched hole unless done at two operations is conical, and weakens the plate to a greater extent than that proper to the size of rivet employed unless the plates are put together with the larger ends of the holes together—a practice inimical to tight riveting and not to be allowed. Then punches and bolsters never do keep in order for long; it is difficult to secure accuracy, and plates become stretched and buckled by the operation. Multiple drilling helps the more mechanical operation of drilling, and with modern machinery all the holes of a boiler shell are not only drilled radially but true to pitch by twist drills which alone ought to be allowed, or other forms of fluted drills. But when drilled the plates must be taken apart and the edges of the holes cleaned with a rose bit to remove the burr and take off the sharp edges of the holes.

Drifting properly so-called is the operation of drawing together unfairly-punched holes so as to enable a full rivet to be inserted. Holes more than half blind to each other were thus forcibly made true, and the evil is so obvious, that even were punching in itself better than drilling, the necessity for drifting would still condemn the practice. As we have already pointed out, a drilled plate, drilled in place, with all its fellow plates and butt strips in position, may legitimately be drawn to place with a blunt drift. What has been truly drilled cannot very well be seriously damaged when put together again with any ordinary care, and such necessary precautions as first putting in rivets at long spaces, so as to prevent the squeezing up of the slight inaccuracies or slacknesses of a seam into one pitch length. Two 8-feet rings of plate cannot be put one inside another without any slack, and even a sixteenth of an inch in a circumference would make an ugly arch on the outside plate when all run into the $2\frac{3}{4}$ inch between adjacent rivets. The planing of all plate edges is useful in trueing up the plates to size and removing all roughness, as well as preparing for the better fullering of the plates after riveting.

The actual operation of riveting is now almost always effected by hydraulic pressure. There is a good deal of variation in practice. It will be sufficient to say here that the rivet when put in ought before closing to be already a close fit in the hole—it should require a blow to knock it in. Then a rivet must only be moderately heated. It must not be so soft as to flow like wax and exert undue bursting pressure on the holes and subsequently to shrink to a loose fit. The rivetter should first press upon the plates which are brought forcibly together, then the pressure to close the rivet is brought into action. This prevents the rivets being squeezed between the plates, a fruitful source of trouble with unclosed plates. Some boiler makers caulk a boiler inside, and for this purpose they will make the inside butt strip narrow, as shown in our illustration, in order that the caulking may be done near the close-pitched seams. In the more correct practice of outside caulking the narrow plate is put outside for the same purpose. Other makers keep both cover plates wide. There are various difficulties as regards steam tightness brought in by the use of butt or cover strip joints, and the outer strip on the smaller rings of a shell requires to be thinned down and tucked in between the plates at the ring seam, for it cannot be end caulked, the edge being out of reach. There is still much inside caulking carried out, but it is not desirable.

With high pressures the space occupied by a seam is considerable. Rivet seams must come above the water line, and they must also break joint with each other. As only one joint, fortunately, now occurs in each ring of end plating the joints in alternate rings occur alternately right and left of the boiler crown, *i.e.*, of the vertical diameter. The occurrence of these wide butt strips renders it impracticable to attach the angle bars for such gusset stays as come in line with the riveted joints on the first and second ring of plates, to such plates. Internally, therefore, the attachment of the gusset stays and the length of the gussets is not symmetrical. The stays must be attached to that plate, be it the first or second, which is not jointed. Thus on opposite sides of the vertical centre line the corresponding gusset stays will differ. This is not a matter of importance, but with modern pressures the rivet seams are becoming so very cumbrous that welding of longitudinal joints ought to be considered, especially now that it has been so long proved perfectly satisfactory for the furnaces. Better still would be the rolling of the plates as solid weldless rings. In bending plates there is always the difficulty of carrying the true curvature right to the ends of the plate. This is effected with tolerable accuracy by boiler makers, who use a heavy curved former plate to compel the plate being bent in the rolls to curve correctly up to its ends. Solid rolled plates would avoid this; they would save about 10 per cent. of the plate now used in the shell of the boiler, and they would increase the strength of a boiler by from 16 to 30 per cent., according to different authorities. We think it safe to say that the economy in plate and the additional strength together would reduce the weight of a boiler for a given pressure at least 25 per cent., and this with a certainty of strength when solid rolled that might still be doubted with a welded joint. We are fully aware that an advantage claimed for a welded joint is that when exposed to overpressure it will begin to fail, and become so leaky before it gives way as to let all pressure escape.

This is doubtful. The recent explosion at Barking at an enormous pressure did not appear to have had any such effect on the shell. The boiler sat still and made no sign of its internal troubles, and the shell finally failed only when such internal forces were set in motion by the failure of some other parts first. We are inclined to doubt this merit of riveted joints. If the Manchester Steam Users' Association are correct in their recent statements as to joint strength, all rivet seams are extremely doubtful in respect of their calculable strength. Given a demand by boiler users for welded rings, and there would soon be demands for such rings upon the plate mills. It is a very usual practice of engineers to decry certain methods until they themselves possess appliances for carrying them out. As soon as such appliances are obtained virtues are discovered in such methods. Now that a full size Lancashire boiler shell can be made from four rings of plate, the inconvenience attaching to the gusset stay

attachments will be increased, and everything points to the desirableness of solid rolled plates. Ingots would be no larger that at present. They would be less, as a fact. The main difficulty would obviously be the proportioning of the ingot to suit the correct circumference and thickness of plate.

(To be continued.)

HIGH SPEED CONTINUOUS CURRENT TRANSFORMERS.

Last week's issue of a contemporary contains an article by Mr. E. K. Scott on continuous current transformers which is certainly very interesting and may lead to radical changes in such machines.

Mr. Scott shows by means of curves that the cost per kilowatt of continuous current transformers is roughly five times that of alternating current transformers, while the ratio of weights per kilowatt is approximately three to one.

If continuous currents are to go ahead, a remedy is required by which the cost and weights of the two types may become more nearly equal. The remedy suggested is that the speeds of rotation of continuous current transformers should be greatly increased. As Mr. Scott argues, there are no difficulties regarding pulleys and belts to be overcome. Hydro-extractors, cream separators, and steam turbines are run at 3,000 or 4,000 revolutions per minute; why cannot such high speeds be applied to motor generators? In order to make this more practicable it is suggested that the shaft should be vertical instead of horizontal, as has hitherto been the custom. "It might be at first supposed," says Mr. Scott, "that putting the armature spindle on end would cause a good deal of friction and wear on the footstep bearing. This need not be so, however, as the footstep can be relieved of a considerable portion of the weight by the simple expedient of placing the armature core or cores out of centre with the field magnets, so that directly the coils are excited there is a strong upward pull. It is common knowledge that the mere proximity of the fly-wheel of a Willans or Belliss engine causes the armature to be placed ¼ inch or more out of centre with its field magnets, so as to neutralise the end thrust, and the writer therefore feels sure that this effect could be utilised to efficiently relieve the weight on a footstep bearing."

If a 30-kilowatt motor-generator ordinarily running at 750 revolutions per minute might be speeded up to 4,000 revolutions per minute, the weight per kilowatt would be reduced to one-fourth and the price to about one-third of their present values.

The idea of such high speeds in connection with direct current machines is novel and requires time to digest. Doubtless Mr. Scott has considered all the contingencies which might arise, and his opinions put forward thus forcibly merit all consideration from others.

As is remarked in another column of the same issue of our contemporary, it is impossible to dogmatise until a machine of the type indicated has been built and tested. We, however, venture to hazard our own opinions, which may possibly suggest further ideas.

Direct current machines, be they generators, motors or motor-generators are troubled by that necessary adjunct the commutator, and, unfortunately, the motor-generator requires *two* commutators. At low speeds the commutator is quite troublesome enough; what will happen if the speed is so greatly increased? The wear and tear will surely be much greater, the short circuits more frequent and the cost of renewal increased. Sparking difficulties will be increased on account of the higher electromotive force of self-induction on break as the brush passes over the commutator segments. We do not say that these are insuperable objections, but they will certainly present considerable difficulties, and it will require much patience and skill to overcome them.

It is not to be supposed that motor-generators can ever successfully rival alternating current transformers, in which the only considerations which need care are those of insulation and ventilation. The difficulties are obviously increased when in addition to these the questions of lubrication, centrifugal force, sparking, &c., are involved.

It is quite common for alternating current transformers to be used to step down from or up to 10,000 or 20,000 volts, and cases are known in which nearly 200,000 secondary volts have been obtained with considerable power behind them. Such results can never be obtained with motor-generators, and where high voltages are required alternating currents become a *sine quâ non*. Still, there will, for some time to come, be a remunerative field for direct current motor-generators, and Mr. Scott will have obtained a valuable result if he succeeds in building machines such as he describes.

REDUCTION OF TELEGRAPH RATES TO INDIA.

We learn that Sir Edward Sassoon, who is chairman of the Committee recently formed amongst members of the House of Commons for the purpose of arranging a reduction of the excessive rates charged for telegrams to India, has given notice of the following resolution for an "early day":—

> To call the attention of the House to the very high tariff for foreign messages maintained by telegraph companies here, with special reference to the flagrantly extravagant charges on Indian messages, and to move for the appointment of a Select Committee to inquire into the whole circumstances connected with the virtual monopoly enjoyed by these companies.

It is understood that Mr. Henniker Heaton will shortly put a question as to the willingness of the Government to grant such an inquiry.

The subject is certainly well worth inquiring into. For some years past we have drawn attention to the remarkable disproportion existing between the amount charged per word telegraphed to India, and the amount per word for telegrams to Australia. In the former case the rate per word is 4s., in the latter, about twice as far off as India, the rate is 4s. 9d. per word. Through the evidence given by the Marquis of Tweeddale (the chairman of the Eastern and Eastern Extension Companies), and Mr. Hesse (the manager of the Eastern Extension Company), before the Pacific Cable Committee, we are now in a better position to understand the "true inwardness" of this matter than we have hitherto been. In this evidence we are told that the sum of 4s. 9d. per word, which the public pay for telegrams between Australia and London, is divided up as follows: 7d. goes to South Australia, which owns the landline which traverses that Colony from north to south; 1½d. goes to Java, where all three cables from Australia are landed, and the landlines of which form the only alternative to the solitary cable from the Dutch landing place to Singapore; 3½d. is paid to the Indian Government for the transit over the landlines from Madras to Bombay; and 2d. to the European Administrations. As to the 2d. paid to the English Government, in the case of a telegram to London, this appears from the evidence to be due for landline rents. These out-payments amount in all to 1s. 2d., leaving 3s. 7d. per word to be accounted for. As far as the 3s. 7d. is concerned, it appears that the total European-Australasian traffic during the year referred to was £310,000, of which the Eastern Extension Company, the proprietor of the lines from Australia to India, took £200,000. The joint-purse lines from India to England taking the remaining amount in the following proportions:—The Eastern Company, £88,000; the Persian Gulf Government line, a little over £8,000, and the Indo-European Telegraph Company, £13,000. From this we gather that, of the 3s. 7d. per word above mentioned, the Eastern Extension Company claim for their line between Australia and Madras two-thirds of the net rate, or, say, 2s. 4½d., while the amount received by those who forward the message on from Bombay to London is only 1s. 2½d. This is a very striking figure, and one which we recommend to the attention of Sir Edward Sassoon's Committee, and others interested in securing reasonable rates to India. We have it here clearly before us, on the best of authority, that a message originating in Australia is carried from Bombay to London for 1s. 4½d. per word, if we include the 2d. payable to meet the terminal or transit tax in Europe. With this figure before us, we can well understand the strong

objection made by the Indian public and their correspondents to the 4s. per word which they have to pay for a telegram from Bombay to London, or from London to Bombay. The grievance under which the Indian telegraphing public has so long suffered can be easily understood when the value of the above comparison is realised. It means that, under present conditions, the Indian public are paying 2s. 7½d. more per word for the transmission of their messages to London, than is paid by the Australasian public for the transit of their messages from India to England, exactly the same distance, over exactly the same route.

The most reasonable conclusion to be drawn from a study of this anomalous position appears to be the following:—The Eastern Extension Company some years ago had to reduce their rate from 9s. 4d. to 4s. 9d. per word, in view of the support which the Australian Governments might otherwise have given to a competing cable across the Pacific, and owing to this, the Eastern Company have come to their aid by taking a diminished share of the profits, as far as the Australasian traffic is concerned. We say profits advisedly, as it would obviously be unfair that the shareholders of the Eastern, or the Indo-European Companies, should bear the burden entailed by carrying Australian traffic over their lines from India, at cost price only. Assuming then that a profit is made on the carriage of Australian traffic from Bombay to London for 1s. 4½d. per word, it is evident that India is very unfairly treated in this respect, and the remedy is equally evident. It was only owing to impending competition that the Australians forced a lower rate from the Eastern Extension Company, and it will only be in a similar way that India will free herself from the serious burden which has so long been imposed upon her by the Eastern Telegraph Company.

CORRESPONDENCE.

Wholesale v. Retail.

With reference to "Disgusted Retailer's" complaint published in your issue of the 16th, perhaps the wholesaler's side of the question might not be altogether amiss, and having been for 10 years in the employ of one of the largest supply houses in England I claim some experience in this direction.

The case which your correspondent cites certainly appears on the surface to be a very hard one, and I cannot think that a self-respecting firm would, knowingly, be guilty of such conduct. "Disgusted Retailer" does not say if the firm in question supplied the goods knowing that they were supplying his customer, as if not there may be some slight excuse found in the natural objection which any salesman would have to relinquishing an order, but if "Disgusted Retailer" informed the firm in question that he was negotiating for the sale of a dynamo of their manufacture, and they still supplied direct to his customer, there is no excuse whatever, and he has at least my personal sympathy.

As having a bearing on this matter, however, I should be glad if I can trespass on your space sufficiently to air somewhat the perplexities which sometimes beset the wholesale supplier. During the whole of my experience I have found it most difficult to draw a hard and fast line between those people who are, and those who are not, entitled to trade terms. For instance, besides the actual electrical profession, there are subsidiary or allied professions or trades which to the electrical engineer pure and simple would not always appear to be entitled to trade terms. To quote an instance, a client of mine called upon me not many days ago stating that he had been tendering for a job at a large wholesale provision dealers, but when he came to the push for the order he was met with the remark that his price was too high, and that the goods could be bought of the firm I represent, less trade terms. On the face of it this man had a legitimate grievance, but on investigation it came to light that the firm in question, besides being provision dealers, were also universal providers on the same lines as the Army and Navy Stores, &c., and consequently entitled to trade terms. Besides universal providers, however, might be mentioned the following:—Plumbers, gasfitters, builders and decorators, shippers, ironmongers, upholsterers, opticians, chemists, all branches of mechanical engineering, photographic and scientific apparatus dealers—all of which expect to receive trade terms off any electrical apparatus they may require, and if they cannot receive it at one firm they will go elsewhere. Of course, some of the above are undoubtedly entitled to trade prices, but others there may be some slight question about. It would be very interesting to learn the opinions of your correspondents on the matter. I feel quite sure that the suppliers of electrical apparatus would welcome any practicable suggestion that would render it possible for them to draw a hard and fast line between the trade and those not in the trade.

I would point out, however, before concluding, that the public are very frequently brought into direct contact with wholesale suppliers through the lack of enterprise on the part of the British tradesman in bringing electrical goods under their notice. It is a fact that in this country there is a large percentage of the population who are ignorant of the existence of certain invaluable commodities, until they are sometimes enlightened by the foreign news column of a daily newspaper. It is thus that the Americans, Germans, &c., frequently obtain credit for being far ahead of us in electrical matters, when, as a matter of fact, although in some cases it may be true, yet in others we can leave them behind; but our middleman is not enterprising enough to get at the public to the same extent as the American or German. He does not understand the difference between "making trade" and "waiting for it." Of course there are exceptions, but I am afraid the above is the rule; the consequence is, when the attention of a private individual is drawn to the existence of any particular apparatus that he would like to have for his own use, he does not generally think of applying to a local electrician, or allied tradesman, but obtains, perhaps through an electrical journal, the names of one or two large wholesale suppliers from whom he can get reliable information.

I do not remember ever to have seen an advertisement of an electrical fitter in any public journal, newspaper, or magazine, that have come under my notice. In the trade journals, it is true, advertisements do appear, but these are not the journals that get into the hands of the public, and even these advertisements, 90 per cent. of them, are those of wholesale suppliers. What is wanted is more energy on the part of the trade, so that the British public are educated in respect of the various appliances and conveniences which electricity places at their service. This cannot be done by the wholesale supplier, or the trade would object; it is, therefore, entirely in the hands of the latter to bring about an increased demand for electrical appliances.

Manufacturer and Designer.

Electric Piping.

The whole electrical community must be indebted to you for so liberally opening your columns to the free ventilation of any and all opinions and ideas that may assist in solving this perennial question of "electric wiring." The relative position of "wiring" interests so vitally affects the progress of the whole electrical industry, that until more satisfactory bases are agreed upon, the matter cannot be kept too prominently before the profession.

In case the approaching holiday season, or the increasing "personal heat" makes it necessary for you to put the closure upon the interesting discussion proceeding under the above heading, I ask to be allowed at this juncture to examine the views already expressed in the light of my particular doctrine.

To-day it is universally admitted that wiring rules have to be simplified; but until we get some definite consensus of opinion upon, and consequent standardisation of the many systems of wiring, it is to be feared that we shall not get a satisfactory and uniform set of rules.

I am inclined to think that had not the correspondence opened upon a somewhat "red herring" track in regard to the question of first cost, the subject would have been dealt with more generally from the point of view of practical requirements and perfect application. The general opinion in respect to the various systems appears to be that each one fills some particular function better than its compeers, and that there are many particular fields for application. Looking

at the question broadly, however, it will be admitted that greater uniformity of system *must* be of immediate advantage to workman, contractor, and the public, and just as gas light service has been developed upon standard lines which are applicable to practically all conditions of work or classes of buildings, so some uniformity must eventually result amongst systems of electric wiring.

On the other hand, it is true that "first cost" is a main condition that has heretofore largely controlled electric wiring development. The general tendency has been towards using those materials which are less costly in themselves, without regard to the fact that it is the "labour element" in wiring construction that has always been the uncertain, uncontrollable, and dominant factor.

It seems to me that the true solution of the problem of meeting lower "first cost," or cheapness, in respect to material and labour *combined*, must be found in the opposite direction, by the introduction of higher quality material that shall be capable of satisfying the necessary requirements in such a manner as to overshadow the importance of the "labour" factor.

We now generally recognise that it is "insulation" of the conductors which we have to permanently secure, and that all insulating materials are not only expensive in themselves, but wanting in constant physical and mechanical strength, and for these reasons present difficulty of installation, with considerable dependence upon good workmanship and the continuance of predetermined conditions. You virtually put this in a few words in the opening passages of your article (ELECTRICAL REVIEW, March 31st) when you say that it seems "that the time has come when some definite expression of opinion should be made in reference to the *mechanical protection* which should be afforded to the insulation of the wires."

Going further, since experience has shown that electric service can be satisfactorily effected with *one* conductor kept properly insulated, why should we double our difficulties by seeking to keep insulation on both conductors? In other words, why do we not adopt "earthed outer" methods as offering a most convenient disposition of material? Had the originators of the pioneer "concentric" systems given more attention to their "labour item" cost by looking to the mechanical perfection of their constructive details, I think the success of this principle of installation would have been more rapid, and that it would have stood out more prominently as a signpost towards true development.

To the writer, then, progress seems possible in these two main directions. As regards the first, I am endeavouring, as you are aware, to promote the introduction of a "steel-armoured insulation," and although you say that I put forward "apparently heretical claims" on its behalf, I am content (providing I can escape absolute martyrdom) to suffer this criticism whilst awaiting the better recognition of the principle.

The wiring system I am advocating in connection with the Conduit and Insulation Company is thought to embody the above principle of "armouring"—in its electrical and mechanical entirety—and to cover all practical conditions.

Whilst thanking you for having published such a full and complete description of the detail parts of our system, we trust you will allow us to take issue with you on some of the points you make when discussing our system under its electrical qualities. You consider our claims under four headings:—(1) Mechanical strength; (2) Incombustibility; (3) Insulation; (4) Convenience in wiring. Although we are glad to note that your summation under each heading must be considered favourable to us, you make some statements which we think can be rebutted.

Under your heading (2) you state that "if a workman is sufficiently careless to scrape the insulation off the wire, there is no reason why he should not equally well damage the insulation inside a box or the conduit." Surely you overlooked your previous conclusion that although the metal piping we employ is not quite so thick and as strong as ordinary gas pipe, it is, no doubt, "amply strong enough," and (as one of your contemporaries expresses it in their "Review of Reviews") this criticism is captious, from the fact that it is easier for workmen to tread accidentally on a coil of wire "than on the inside of a metal pipe."

Coming to your third heading, in which you state that "infinite precautions" must be taken when employing gas pipes and other forms of bare metal conduit, we would point out in comparison, that upon the adoption of our insulated conduits, the necessary precautions need only be few and definite. You say "it is not stated how surface leakage is to be prevented," to which we would reply that surface leakage in all metallically-armoured wiring systems usually occurs at the jointing and outlet points, and as in our system we consistently arrange an insulating lining inside all joint and outlet boxes, we find in practice that surface leakage can be reduced to a minimum. Your point as to "water, lime, and other foreign substances getting into the conduit and boxes," is, we admit, applicable to all conduit systems, but we find that such substances have less effect on our bituminous insulation than upon its armouring, and since we urge that our conduit system should be completely installed and "plastered up" *before* the wires are brought into the building, there is every reason that the race-ways will be cleared of any foreign materal that may get into them before the wires can be passed through. As to the "inducement to the contractor to be wicked enough to put an inferior class of insulated wire into our conduit," we would point out that every wire should be accessible, and can, therefore, always be examined; whilst our experience with a "bare copper" conductor arranged in an earthed-outer system, shows that the insulating lining we employ can, if necessary, be completely depended upon by itself.

As we consider that in the process of development it would be only a half measure, we have hitherto refrained from advocating the use of insulated wires other than the present accepted standards. The use of cheaper wires would indeed lessen the cost of our system, and, we think, *without* any increase in fire risk, for looking to the large and increasing use of "flexible cord," (installed under open-air conditions), where would be the risk of employing wires of similar quality *throughout*—under floors and in walls—provided they were run in an armoured insulating tube? Such practice, however, cannot fully meet the question of how to compete in first cost with ordinary gas pipe service, for the placing of two wires in any kind of pipe already makes its cost excessive without regard to the cost of the insulation.

You make the statement that "were wires with less insulation used, there would be no special advantage in the matter of cost, "because the insulated conduit has to be larger by the thickness of the insulating lining, and therefore more expensive in proportion." In doing so, are you not forgetting that as now made our conduit has the same inside and outside diameter as standard gas piping, and overlooking the fact that experience in other countries is showing that where no insulating lining is employed, it is necessary to provide the wires with an extra braiding (consequently increasing their diameters) in order that they may better withstand the drawing in? Also, is it not a fact that when ordinary metallic piping is specified, most consulting engineers call for "suitable bushings" to be provided at the drawing in points? As a matter of fact, therefore, the working diameter of the bare tube is practically limited to the inside diameter of the bushing. On the matter of relative diameters, therefore, the question seems as broad as it is long.

The "continuity" of our insulating lining is assured by the process of manufacture, and you will have noticed that none of your correspondents who have had practical experience with our material have raised any criticism on this point. The joining of the pipe is, of course, its weakest point, but our conduit, with tightly screwed joints, when placed under water, and test made to a bare copper wire inside the lining, will show an insulation resistance of 20,000 megohms per joint, and this can be still further increased if extended experience shows the necessity. I think you will agree that "this weakest link" is a tolerably strong one. I might here add that the simple "millivolt" test referred to by Mr. Schwartz, of the South-West London Polytechnic Institute, provides not only a means of checking the metallic perfection of the joint, but also serves as a guide to its insulation resistance.

Although we have in England no effective means of estimating the actual fire loss that occurs through electrical agency, I accept your criticism as to the undesirability of harping upon the electrical "fire bogey" and agree that the electrical engineer should make it his aim to minimise the danger in the eyes of the consumer. You will agree, however, that amongst ourselves, all the possible dangers should

be known, and I still maintain too much reliance is being placed in the "fuse" (referred to by you as "the slender thread that stands between perfect security and complete combustion") as *the* means of providing "safety."

For an analogy, you say that "one should not argue against the sale of razors because sometimes people cut their throats with them"; on the other hand, you will allow that if razors were always placed in the hands of children it might be wise to sell them under additional precautions. You state that "a person who inserts a copper wire fuse in the place of a tin one, deserves no more sympathy than the man who ties down a safety valve," but you forget that those usually placed in charge of a safety valve are so employed because of their trained experience. Fuses are undoubtedly useful in the hands of a trained electrician, but if the public are called upon to pay 10s. a time for their replacement, it is not to be wondered at that they often prefer to replace them themselves. Further, if the public is as you suggest, to gain its knowledge by experience, may not such experience be as injurious to electrical interests as it would be costly to them? On the whole, therefore, I prefer that "common sense" should be found by the experienced electrician, and that he should provide the public with a method of wiring which relied upon its *inherent qualities* for safety, rather than upon auxiliary devices which have to be placed in the hands of others.

The correspondents who testify to the facility with which steel armoured insulating conduit *can be bent cold* on the job, answer your question as to how our conduit can be made to cross girders, and dodge gas and water pipe systems, and discounts the advantage you state ordinary gas pipe offers, in that it can be made red-hot at the forge, and set to the exact curve required. Your correspondents also indicate the difficulty that exists in handling and bending an "open seam" or split tube, better known in the Birmingham bedstead trade as "close joint steel tube." You suggest that many arguments and points made against plain iron and steel piping can be overcome by the use of weldless steel tubes; but here, again, it will be found that their high first cost prevents their receiving a fair trial, particularly when placed on the same basis for competition (by "Rules and Regulations") as any "tube" or "trough" drawn up from the strip, and which makes no pretence to having watertight qualities. It should be noted also that in spite of the introduction of several "tubes" of this nature (many even falling below "nail proof" thickness in material), wiring *per se* has not, as you yourselves point out, really been cheapened, so that unless it is for ever to remain a "luxury" to the few people well-off, it would seem necessary to inaugurate some radical change from our present methods.

I admit that the question of earthing one pole of installations supplied from public mains is a very large one, but if the supply companies have "excellent reasons" for steadily refusing to sanction this practice, it is full time we were told about them. It seems that it is upon this point that further discussion should be invited, and if serious objections can be put forward, let us try to design suitable street main services and reliable "low cost" wiring systems, so as to place electrical supply within the reach of the majority.

The writer's opinion is that the word "earthing" leads us to surmise difficulties, and that the ground would be cleared for discussion if we talked of earthed concentric systems as those which had one conductor arranged at *earth potential*, and keep in full view the fact that this conductor should be of ample capacity to carry its current with a very small drop in voltage.

Under the present allowance of 2 per cent. drop on a house circuit, one volt would be the potential difference between the extreme ends of the "outer conductor." Can electrolytic troubles, due to the work of the wiring contractor, be conjured up under these conditions? On the other hand, it must be allowed that the central station engineer will certainly have his particular conditions to consider, but is he willing to admit that he cannot arrange to take care of his part of the contract? Can they not let us have "more light" thrown upon the troubles to be expected under such conditions? If we are allowed to maintain "insulation" upon one wire only, the "cost" question is more than half solved, and the possibility of providing efficient mechanical and electrical armouring can be squarely faced.

The recent "free wiring" development shows how station loads can be increased in every kind of district, but does not really strike at the root of the question. What we want is fair and square competition with gas service in respect to cost, convenience, and applicability.

If rules and regulations did not tie us down, practical tests and experiments could be more readily conducted with a view to elucidating the above questions, for so far fact and evidence distinctly encourages us to persevere in the direction of higher quality material.

Our poetic imagination even suggests some such modification of your Lewis Carroll stanza as:—

> The wireman and the carpenter
> Were at an installation,
> They wept like anything to see
> A better use of insulation.
> "Earthed outer" ways had come to stay,
> So they had lost life's station!

Naturally it cannot be that any change or development takes place without opposition. Prejudice and custom are too deeply rooted, vested interests create opposition, and discouragement must be faced from authorities and workmen.

The same main idea seems to be at the bottom of it all, (and with a double apology to your poetic muse) it can be expressed like this:—

> Says your wireman Mike
> To his carpenter Bill,
> "But conduit men are fitters!
> Unless we strike
> Our 'job' they'll fill,
> And where are *we* poor critturs?"

In respect to the particular canoe in which I have embarked in order to meet the storm of discussion, if it is not designed to survive, the sooner a man-o'-war in the shape of a thoroughly practical wiring system comes along and swamps me, the better it will be for the peace of our many distracted contractors and

Fred. Bathurst.

July 23rd, 1899.

Formers for Eickemeyer Coils.

I should esteem it a favour if any of your readers could give me any idea of the shape of formers used for Eickemeyer armature coils; also if this winding is a valid patent; if so, what is the patent number and date?

Thanking you in anticipation of your kindness in publishing the above in your next issue of the ELECTRICAL REVIEW.

J. W. Holt.

The Measurement of Alternating Currents.

In Prof. Ayrton's paper on the above subject, as reported in your issue of June 16th, methods of measuring alternating currents are given, and errors and defects in instruments for the purpose are pointed out. The necessity for an apparatus for testing the insulation of cable when laid is also referred to. The author does not seem to be aware of the existence of (1) Lord Kelvin's ampere balances, (2) Lord Kelvin's multi-cellular electrostatic voltmeters, and (3) Lord Kelvin's insulation testing set.

1. I take this opportunity of pointing out that the Kelvin ampere balance is designed and largely used for measuring alternating as well as direct currents. It is generally recognised as the most accurate and convenient means of making measurements of current. On alternating circuits no error is introduced by changes of periodicity.

2. Regarding the electrostatic voltmeters:—From this type of instrument it is impossible to dissociate the name of Lord Kelvin. His multi-cellular electrostatic voltmeter is in use in nearly every central station and electrical laboratory. It is recognised as the standard instrument, being alike suited for use on direct or alternating circuits, and free from error due to stray magnetic fields or temperature. In this instrument (as its name implies) the fixed inductor consists of a number of cells, and on the movable system are provided a corresponding number of vanes. In this way sufficient working force is attained without resorting to the very questionable method of coating the cells or vanes with mica or enamel to prevent brush discharge or sparking. All Kelvin multi-cellular electrostatic voltmeters are designed to withstand without sparking or brush discharge a voltage equal to

at least double the maximum scale reading. There is no error from pivot friction, and the damping can be made absolutely perfect.

3. Lord Kelvin's testing set for the measurement of insulation resistance is an apparatus contained in a small case weighing about 14 lbs. It is arranged to fit on a tripod stand for convenience in making tests on mains when being laid. With 200 volts on its terminals, insulation tests up to 1,000 megohms can be made; and with higher voltages correspondingly higher insulations can be tested. This testing set has been found to be sufficiently sensitive for all ordinary purposes, while at the same time it is able to withstand the rough usage of every-day work on street main testing.

James Ferguson,
Manager, Electrical Department,
James White, Glasgow.

June 23rd, 1899.

THE TELEPHONE SERVICE.

In the House of Commons on Monday, on the order for the resumption of the adjourned debate on the motion for the committal of the Telegraphs (Telephonic Communication, &c.) Bill to the Standing Committee on Trade, Mr. Hanbury (according to the *Times* report) said that perhaps he might take that opportunity of stating to the House what were the arrangements which had been made with regard to the National Telephone Company since the subject was last before the House. There were three points which he had discussed with the company. The first was the difficulty which had arisen with regard to certain large boroughs where the National Telephone Company had practically done away with the overhead system, and had spent considerable sums of money in establishing an underground system. That was done before there was any probability of any Bill of this kind being introduced into the House, and that money was expended although the ratings granted were granted under leases founded on very short notice. There was a strong fear expressed on behalf of the National Telephone Company that the corporation of a borough which, under the Bill, had new powers given it to establish a telephone system of its own, might see its way to establish a monopoly of the telephone within its borough, and give notice to the Telephone Company to terminate its wayleaves in six months, thus confiscating a large sum of money. That, of course, was an event not at all likely to happen, though, of course, if such a corporation did take such a step it would be sheer confiscation, and, therefore, he agreed that it should be a condition of any license to any corporation or company, where such money had been expended, that those wayleaves should be practically secured to them during the remainder of their license. That was only a fair step to take. In the first place, it was no great concession, for he believed no corporation would have behaved in the way the company thought possible; but as a condition of so securing their wayleaves he required that the company should come under control. One of the great complaints made against the company was that it was unregulated, that there was no control over their rates, either *maximum* or *minimum*, and that they were not obliged to treat with the public at all on equal terms. In the future the company would be prohibited from granting any preferential terms whatever.

Sir James Fergusson: They never did.

Mr. Hanbury: At any rate that would be impossible in the future. The second point was that he realised that, if they were going to induce either new companies or special corporations to embark on that work, a license extending only to 1911 was hardly sufficient temptation to them. He thought they ought to give to those new companies and corporations a substantial term of either 20 or 25 years, and if they were to do that, it would be grossly unfair, he thought, not to extend the National Telephone Company's license also, subject, however, to the same restrictions and prohibition of preferential rates. Everywhere the company would cease to be a monopoly. In those limited areas where the company had already exchanges, competition would be encouraged by the Bill, and the company had undertaken to enter no new areas—that was to say, that, whereas under existing conditions they had a perfect right to compete throughout the whole of the country, in future the license would be so limited that they would not be able to set up exchanges in any area whatever. That, of course, would be a great protection to the smaller municipalities, where there was no exchange at present, and where the National Telephone Company would be prevented under the present Bill from setting up competition. He hoped the House would acknowledge that the company had treated the Government most fairly, and he trusted that, now they had come to terms, the result would be a more efficient service throughout the length and breadth of the land. The House would, he hoped, deal with perfect fairness by the company now that terms had been arranged, and allow the Bill to be sent to the Standing Committee.

Mr. Cohen (Islington, E.) moved to omit the words "Standing Committee on Trade," and to substitute "Select Committee of this House." He recommended that course because new considerations were now involved in the Bill.

Mr. Kimber (Wandsworth) supported the motion for a Select Committee, and was speaking at midnight when, by the rules of the House, the debate stood adjourned.

The debate was continued on Wednesday, and in the end the motion that the Bill be committed to the Standing Committee on Trade was agreed to.

LEGAL.

Hodges v. Woodward Electrical, &c., Company.

This case came before a Divisional Court of Queen's Bench, composed of Justices Grantham and Kennedy, on Tuesday, on the defendants' appeal from the judgment of Judge Lumley Smith sitting at the Westminster County Court.

Mr. Arnold Statham, in support of the appeal, said the simple question was whether or not the promoters of the company, which was a newly formed company, were liable for the cost of some preliminary tests made of electrical apparatus. It was not disputed that the tests were properly made, and were of a satisfactory character, nor was the amount of the bill contested; but the defendants said that the cost should properly have fallen upon those who were promoting the company. These tests were made before there had been any formal meeting of directors.

Mr. Justice Grantham: Was the company registered?

Mr. Statham said it was, and that the tests were made after the registration of the company. It was quite clear that in any case the promoters were liable with the company, but the company contested any liability. A Mr. Shippey, who was one of the promoters of the company, wanted to become its consulting engineer. He induced the company to take up these tests, which were very expensive and elaborate, and premises were hired for the purpose. He invited a number of gentlemen down, some of whom became directors of the company, and they saw what was going on and what was done, and said the tests were very satisfactory, and they were very well pleased with all they had seen, and so on; but when they went down they had not the faintest idea that it would be suggested that their presence there constituted an authority by the company for those tests. Mr. Shippey afterwards sent in a report to the company, which received it. Really this document was secured by the promoters in order to enable them to form the company. The learned counsel submitted that on the facts shown there was no evidence that any of the directors of the company gave authority that the company should be responsible for the costs of the tests.

Without calling upon counsel for the other side, Mr. Justice Grantham said the sole question before the Court was whether or not there was evidence upon which the learned County Court judge could have found as he had found. His Lordship was of opinion that there was some evidence, and therefore the appeal failed, and must be dismissed with costs.

Mr. Justice Kennedy concurred.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending June 28th, 1898.		Week ending June 27th, 1899.	
Adelaide	Value £261	Adelaide	Value £75
Amsterdam	25	Alexandria. Telep. mat. ..	282
Antwerp. Elec. fuse	876	Amsterdam	80
Bombay	300	Antwerp	48
Boulogne	14	Archangel	47
Calcutta	141	Bangkok	34
Cape Town	122	Bilbao	40
Colombo	201	Bombay	160
Durban	98	Boulogne	21
,, Teleg. mat.	569	Calcutta	636
Hamburg	310	Cape Town	962
Lisbon	1,000	Christiania	99
Malta	160	Colombo	70
,, Teleg. mat.	117	Copenhagen. Teleg. cable ..	109
Melbourne	48	Delagoa Bay. Teleg. mat. ..	41
North Sea. Teleg. cable ..	9,448	Demerara	31
Port Elizabeth	112	Durban	560
Rotterdam	48	East London	52
Santos	60	Flushing	10
,, Teleg. mat.	35	Gijon	3,500
St. Petersburg	117	Gothenburg	42
Singapore	137	Kronstadt. Teleg. cable ..	600
,, Teleg. mat.	68	Launceston	51
Suez. Teleg. mat.	41	Madeira	21
Sydney	594	Malaga	55
,, Teleg. mat.	168	Marseilles	20
Teneriffe	20	Melbourne	247
Vera Cruz	10	Odessa	50
Vigo. Teleg. mat.	11	,, Teleg. mat.	200
Yokohama	883	Ostend	97
		Penang. Teleg. mat.	50
		Port Elizabeth	467
		Rio Grande do Sul. Teleg. mat.	343
		Rotterdam	31
		,, Teleg. mat.	180
		Shanghai	398
		St. Petersburg	109
		Stockholm	143
		,, Teleg. wire	62
		Sydney	489
		,, Teleg. cable	1,170
		Tientsin. Teleg. instruments ..	427
		Wellington	145
		,, Teleph. mat. ..	950
Total ..	£15,555	Total ..	£13,128

Aluminium Coating for Street Standards.—Messrs. Smith, Simpson & Co., Limited, of Manchester, are supplying "Simpson's patent aluminium coating" for trolley poles and arc lamp pillars. Anything that will improve the appearance of street poles of electric tramways, and thus undermine the antipathies of the champions of æstheticism, will meet with a welcome from the borough electric tramway engineer and director. But aluminium coating, it is claimed, would not only

improve the appearance of cast-iron or steel poles, but would do away with a great deal of painting work, and prevent rust. A communication from the makers says that the coating, which may be applied as easily as ordinary paint, has been well tested by Mr. R. C. Quin, the Blackpool electrical engineer, and all the new combined lighting and tram pillars on the promenade there are to be treated with it.

Auction Sale.—On July 11th next at the Portsmouth Dockyard, a sale will be held of various stores, including 14 tons of electric cables and five dynamos. Particulars may be had of Messrs. Fuller, Horsey, Sons & Cassell, of 11, Billiter Square, E.C., who are the auctioneers.

Bankruptcy Proceedings. — The creditors of Alec Gavan Inrig, electrical engineer, 46, White Post Lane, Victoria Park, lately trading as the Globe Electrical Company, met on Wednesday at the London Bankruptcy Court, before Mr. H. Brougham, official receiver. The debtor states that he came over from Antwerp in September, 1895, with a capital of £1,000, he having traded there for several years. He expended £500 in machinery and commenced business at the above address in his own name. Seven months later he was joined by a Mr. Arthur Chester who proposed to introduce £500 into the business on the condition that it was converted into a limited company. That step was taken, and although Mr. Chester received shares for £500, he only paid in £198 of the agreed sum, his promise to pay in the remainder falling through. A few months after the company was floated Mr. Chester negotiated a bill for £500, for which the company was responsible, and then he absconded. The company was thereupon wound up and the London and District Bank, Limited, who were the holders of the bill, bought the estate from the official liquidator for £120 in December, 1896, and employed him (debtor) as manager of the business. A hiring agreement was also prepared under which he was to re-purchase the business, but no payments had been made thereunder. The capital to carry on the business was provided by the bank, who charged 10 per cent. interest for it. They received all the takings and paid the accounts as they became due until last November, when they stopped supplies. The debtor asserts that he is not responsible for the debts of the business which he has recently closed, and a receiving order has been obtained against him by the bank. He attributes his failure to the action of the petitioning creditors in refusing to meet the liabilities of the business as they became due. The chairman reported that accounts had been filed showing debts £1,103 14s. 10d., against assets £330, comprising stock which cost £200, and was expected to realise £30; machinery cost £764, and valued at £200; and fixtures, fittings, &c., estimated to produce only £100, although they cost £900. The question of the ownership of the business would have to be carefully investigated, and it appeared to turn to a large extent upon the agreement between the debtor and the bank. In reply to the chairman, the debtor said he regarded himself as a servant of the bank. He was paid by them, and his name figured with the other men in the weekly wages list. They originally paid him £5 a week, but afterwards reduced the amount to £3, saying that the business would not stand the larger sum. They kept all the books of the business, and, in fact, had complete control of it. He (debtor) ordered the goods in the name of the Globe Electrical Company, and signed "A. G. Inrig, manager." In the absence of any offer, Mr. E. H. Hawkins, accountant, 3, Barbican, E.C., was appointed as trustee to administer the estate in bankruptcy assisted by a committee of inspection. The public examination of the debtor is fixed for July 20th. Appended is a list of the principal creditors, viz.:—Unsecured—Dorman & Smith, Salford, £52; Greengate Rubber and Cable Works Company, Salford, £62; General Electric Company, London, £63; W. T. Glover & Co., Limited, Salford, £232; Houlder Bros. & Co., Limited, London, £72; Alex. Shanks & Son, Limited, London, £120; and sundry smaller creditors, amounting to £415.

A receiving order has been made in *re* J. G. M. Hilton, electrician, Trafalgar Works, Bow Common Lane.

Mr. B. S. Dunn, 10, Coleman Street, E.C., has been appointed trustee in the case of E. L. Joseph, electrical engineer.

At the Glasgow Sheriff Court on 23rd inst., the examination of Harry Wilks, electrical engineer, of Holland Street, was resumed. The statement of affairs represented the assets to amount to £288 exclusive of land and houses in Manila, estimated by bankrupt to be worth £4,000. The liabilities were stated to amount to over £1,615.

The first meeting of creditors under the failure of G. T. Godfrey (Godfrey Bros., builders and electrical engineers, Balham and Tooting), was held on Monday at the offices of the official receiver for the Wandsworth District, Railway Approach, London Bridge, S.E.

The case of Edward L. Joseph, electrical engineer, late of the Northampton Works, Northampton Grove, Canonbury, and managing director of Williamson & Joseph, Limited, came before Mr. Registrar Hope, on Thursday, at the London Bankruptcy Court, it being in the list of the day's examinations. It appeared, however, that the trustee had only just received his certificate of appointment, and required further time in which to conduct his investigations prior to proceeding with the public examination of the debtor. By consent of all parties the hearing was adjourned to July 13th.

Liquidation Notices.—The *London Gazette* contains notice of the voluntary liquidation of Messrs. Williamson and Joseph, and the appointment of Mr. S. P. Child, 42, Poultry, E.C., as liquidator.

A second notice says that on June 14th Mr. Justice Wright made an order that the voluntary winding-up of Messrs. Williamson & Joseph, Limited, should be continued, subject to the supervision of the Court.

The London and Lancashire Electric and General Engineering Company is to be wound up voluntarily, Mr. F. A. Franklyn being appointed liquidator.

A meeting of Electricity, Limited, will be held at 62½, Fore Street, E.C., on July 28th to receive the report of the liquidator, Mr. P. W. Davis.

In the Chancery Division on Monday a compulsory winding-up order was made against the Chitty Dynamo and Motor Company, Limited.

Changes of Address.—Mr. W. L. Preece notifies that his address is now 13, Queen Anne's Gate, and not 39, Victoria Street.

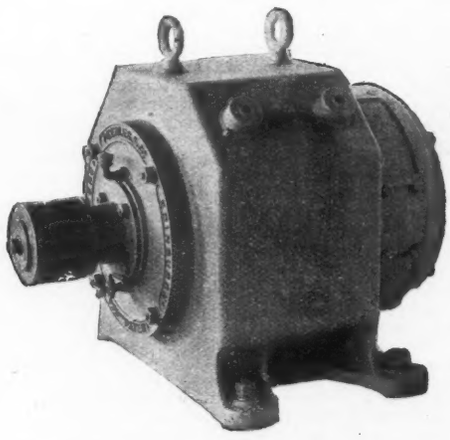
Messrs. Sanders & Co., general agents for Messrs. Burnham, Williams & Co., of the Baldwin Locomotive Works, have removed their London office from 36, Lime Street to 110, Cannon Street, E.C.

Mr. Carl Quiltmann, electrical importer and agent, has removed from 17, Jewin Crescent, E.C., to 3, Cloth Street, Aldersgate Street, E.C.

Dissolutions of Partnership.—Messrs. P. H. Tewson, and R. H. Streatfeild (Tewson & Streatfeild, electrical engineers, Bucklersbury, and Regent Street, London), have dissolved partnership. P. H. Tewson attends to debts.

Messrs. H. Nuttall, F. W. Heaton, and H. Smith (Heaton, Smith & Co., electrical accessories manufacturers, Salford), have dissolved partnership.

D. Bruce Peebles & Co.—Although the manufacture of "P.P.P." multipolar enclosed and protected motors and generators has only been started a comparatively short time, the enormous amount of work now on hand has rendered it compulsory for Messrs. Bruce Peebles & Co. to erect large new works, which will more than treble their present capacity. Amongst the most important contracts executed or in hand, since the beginning of this year alone, may be mentioned: Several hundred horse-power in crane motors and generators for the Scottish Freestone Quarries, Closeburn, and New Cove Quarries, Ecclefechan; the electrical power transmission of the large hothouse factory of Messrs. Mackenzie and Moncur, Edinburgh; complete equipment of the Stirling Boiler Company's shops, Edinburgh; some hundred horse-power in motors for the iron foundry of Messrs. Mackenzie Bros., Edinburgh;



complete power equipment of the Telegraph Manufacturing Company's works at Helsby; several 100-kilowatt generators for the West Kent Electric Supply Corporation; pumping installation for Sanquhar Quarry; lighting plant for the Consett Iron Works Company; four 150-kw. motor generators for the Corporation of Glasgow; 200-kw. traction generators and boosters for Aberdeen Corporation; 110-kw. traction generator for Corporation of Dewsbury, &c.; several hundred horse-power in enclosed motors for Messrs. Holloway Bros., Islington, comprising several 70 H.P. enclosed motors, which are amongst the largest standard enclosed type motors in the country; also motors for various central stations, for pumping, driving economisers, destructor blasts, stoking, ventilating, and various industrial purposes, for the Corporations of Canterbury, Middlesbrough, Pembroke, Rochdale, Pontefract, Liverpool, Bradford, Manchester, &c. We understand that Messrs. Bruce Peebles & Co.'s traction generator department is assuming large proportions, and there shortly will be erected some of the finest heavy machinery obtainable to deal with this class of work to the best advantage. Standardization and special design and finish are claimed to be highly responsible for the success of this firm.

List.—Messrs. Fletcher Bros., of Ashton-under-Lyne, send us a list describing their pendulous isolating valve.

London County Council.—It was decided at a meeting of the Council on Tuesday to lend £10,000 to the Newington Vestry for electric lighting purposes, this being the fourth instalment of a total sum of £50,000. As in the case of the previous instalments it was agreed that no repayment of principal should be made during the first three years, the repayment being distributed over the remaining period of 39 years.

The Highways Committee reminded the Council that the Board of Trade had granted a provisional order to the Charing Cross and Strand Electricity Supply Corporation in respect of the City, under

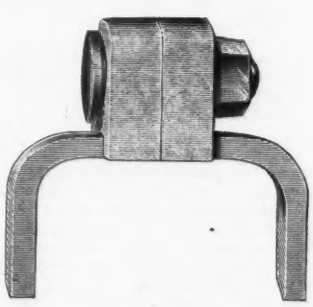
the title of the City of London Electric Lighting Order, 1899. The provisional order had been brought into conformity, as regards provisions relative to the Council's embankments and subways, with those issued in 1890 for the same area, and it contained an additional provision, not inserted in those orders, that the Council should be supplied with a map showing the area of supply under the order. In addition to this the Committee stated that the order contained a new clause providing that the generating station might be situated outside the area of supply, but that the approval of the local authority concerned was necessary before a station could be built in its district.

It was reported that Mr. D. Hay, one of the joint engineers of the City and South London Railway Company, had on behalf of that company and of the London & Brighton Railway Company, submitted for the approval of the Council plans showing proposed arrangements in connection with the joint subway between the first-named company's station at Denman Street and the latter company's London Bridge station. The company's engineers stated that the Board of Works has raised no objection to the plan, which the County Council decided to approve.

The Parliamentary Committee reminded the Council that on the 20th inst. they reported that clauses and an agreement had been provisionally settled with the promoters of the London United Tramways Bill, and that they had instructed the Parliamentary agent to withdraw the opposition of the Council, provided the company agreed to those terms. The Committee now stated that the company had accepted the clauses and agreement, and that the Council's objections had consequently been withdrawn.

The Council resolved, on the recommendation of the Building Act Committee, to approve plans submitted on behalf of the Vestry of Islington for an addition to the generating station in Eden Grove, Holloway. It was also decided to approve plans for the conversion of an existing building into a generating station in Osborn Street in accordance with plans submitted by the Whitechapel Board of Works.

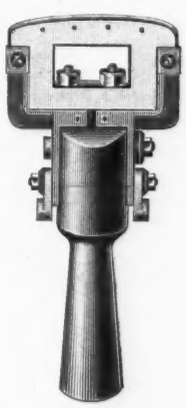
The Hart Secondary Battery.—We have received from the Hart Accumulator Company, Limited, a sample positive grid of their latest lighting type plate, and also one of their patent non-corrosive connections, of which we give an illustration. In the grid, each pellet is securely locked in its place by a small leaden lip rolled over by a special process, the paste being thus kept



firmly in position. The same principle is carried out in all the Hart types, especially the traction type, the result claimed being that it is impossible for disintegration to take place. Buckling is declared to be prevented by strong ribs running diagonally across the plate, which strengthen it. The grid is constructed on the girder principle with lattice work arranged alternately on either side.

Municipal Trading.—At a meeting of members opposed to the extension of municipal trading, held in one of the committee rooms of the House of Commons on Monday, Sir John Lubbock presiding, a resolution was adopted, on the motion of Mr. Charles McArthur, seconded by Mr. Kimber, expressing regret that the Government have, up to the present, found themselves unable to appoint the joint committee on municipal trading which was promised at the commencement of the Session, in concurrence with the resolution of the Society of Arts and the London and other Chambers of Commerce—"That it is inconsistent with such promise to confer further powers for trading purposes on municipalities until such committee has investigated the subject and reported thereon." The *Times* says that the following were appointed an executive committee to watch future developments and initiate such action as may be deemed necessary:—Sir John Lubbock (chairman), Mr. C. McArthur, Mr. Whitmore, Mr. W. L. Lawrence, Mr. Boulnois, Mr. Bonsor, Mr. Jackson, Mr. Kimber, and Mr. Cohen (hon. secretary). A copy of the resolution referred to above was, after the meeting, forwarded to Mr. Balfour.

The Removal of Wool from Skins by Electricity.—A process has recently been patented by a Bradford syndicate for removing wool from skins by means of an electrical apparatus. The invention originated with a Bradford lady, Mrs. S. L. Johnson, and consists of an electric cautery or fleshing knife in such a handy form that the wool may be shorn or cut from the skin rapidly, and without injury either to the wool or to the pelt. The form of the apparatus, which is held by the hand, is shown in the accompanying illustration. Electric cables which pass through the handle, and which are not shown in the illustration, are connected to the two terminals and from thence the current is passed through a wire of platinum-iridium alloy, which is thus rendered incandescent. The wire is fastened to and supported by a highly refractory substance, specially made for the purpose, the current required being about 60 amperes at a potential of 4 volts. The method of removing the wool is simply to push the cautery along the surface of the skin. The red-hot knife—if it may be so called—immediately mows down the wool, and the only limit to the speed at which the work can be done is the deftness of the operator. The work is performed so quickly that the heat in no way injures either the skin or the wool. It is estimated that a girl, with a few hours' practice, would be equal to de-wooling from eight to a dozen skins per hour, and the cost of the current is so exceedingly small—being estimated at the thirty-sixth of a penny an hour—as to be almost a negligible quantity. The advantages of this system of pulling will be obvious. The wool itself is not injured by lime, chemicals or any other objectionable influence; the mere singeing of the end of each fibre is, indeed, imperceptible, and might, possibly, be even found to be advantageous rather than otherwise. The skin, which presumably has been sun-dried in Australia or South America, immediately after the slaughtering of the sheep, is in itself in a more perfect condition for the tanner to deal with, and the cost of the process must work out at something very much less than any of the prevailing systems. It is estimated that, in any of the present methods, it costs the fellmonger 4d. per skin to wet down, lime stove, or sweat it into a condition for the puller, and the pulling wages range



from 5½d. to 8½d. per dozen skins. The cost of the apparatus is a mere trifle, and it is obvious, therefore, that this invention promises to effect such an economy that it will, as stated above, practically amount to a revolution in method. Some of the largest fellmongers and tanners in the country, as well as many leading combers, and others engaged in the trade in Bradford, have seen the invention at work, and, without exception, have signified their marked approval of the idea. The number of sheep annually slaughtered in Australia, South America, in this country, and on the continent of Europe, runs into many millions, and except during a very brief period of the year—about shearing time—these sheep are killed with the wool on the skin. How to get the wool off is a problem which has had many solutions. The most common processes in general use, perhaps, are the steeping of the skin and wool in lime water, and the sweating of the skins by steaming them, and piling them one upon another, thus inducing an incipient stage of decomposition. In both instances the wool is pulled from the skin by hand, and the process is most obviously an offensive one. Moreover, both wool and skin suffer to some slight extent in quality, and especially in the case of limed skins is wool deteriorated.

St. Helens Cable Company.—This company, of Warrington and St. Helens, has been formed with a nominal capital of £50,000 and £32,000 in debentures. The company has its own wire drawing plant in St. Helens and large and commodious works for the manufacture of all classes of electric cables at Warrington. It is also adding an up-to-date rubber manufacturing plant, so that rubber cables will be manufactured at a low cost, saving all intermediate profits. The same department will also manufacture general rubber goods, specially for electrical purposes, and we hear that some new specialities for the equipment of central stations are to be manufactured in this department. The management of the electric cable and rubber works is in the hands of Mr. G. E. Heyl-Dia. The St. Helens works will be principally occupied with Admiralty and other contracts for steel ropes, while they will also produce the copper wire for the cable department works at Warrington. Mr. G. E. Heyl-Dia is chairman, and he and Mr. William John Glover, are managing directors.

Sale.—Offers are invited for the sale by tender in one lot of the stock-in-trade (electrical fittings and accessories) of Binko, Ridsdale & Co. (in liquidation). See our "Official Notices" this week for further particulars.

Smoke Nuisance.—At Bow Street, last week, two summonses were down for adjourned hearing against the Charing Cross and Strand Electric Supply Corporation, Limited, charging them with having allowed a smoke nuisance to be caused by their furnaces. Mr. Avory had submitted that the company was entitled to exception under Section 24 of the Act, they having taken every means to prevent the escape of black smoke compatible with the fulfilling of their statutory obligations with regard to the supply of electricity,

but Sir James Vaughan now said that this, though having an important bearing on the determination of the penalty to be inflicted, could not be an answer to the charge if the existence of a nuisance were proved. Evidence was given to show that only the best possible coal and the best known furnaces were employed, and that black smoke was emitted only for a minute at a time a few times during the day immediately after stoking, and this was inevitable. At the company's works at Lambeth the difficulty had been overcome by the use of different boilers and a forced draught, but here it was a question of space. Mr. Avory said that in order to enlarge their premises the company would have to purchase two theatres and a church. Sir James Vaughan said, according to the *Times*, that if the company had succeeded in abating the nuisance at Lambeth they must be able to do so at their works in Maiden Lane. At any rate, they should make an effort in this direction, and the non-success of this effort would be the best answer to any future summons. The defendants were fined £5 and £5 5s. costs on these summonses, and a further summons which had been adjourned *sine die* that an expert might report on the construction of the furnaces was withdrawn on the payment of £5 5s. costs.

The Great Central Railway Company has been fined at Marylebone for permitting black smoke to issue from its hydraulic and electric lighting works chimney at Grove Road, St. John's Wood. The company was fined £5 on each of two summonses with £10 10s. costs, and an abatement order was made in reference to another summons with £2 2s. costs, and another summons was dismissed.

Trade Announcement.—Messrs. Burnett & Jones, electrical engineers and contractors, have recently taken new premises at 30, Kingsland Road, Shoreditch.

Trade Routes.—*Sell's Commercial Intelligence* issues with its July 1st number a double-page map showing the great alterations which are expected to be made in the trade routes throughout the world in the near future. This should be of interest to exporters to foreign parts.

Tramway Manuals.—With reference to our review of "Duncan's Tramway Manual" last week, Mr. W. Alderson Smith, of Donington House, W.C., writes as follows:—

> In your comments last week on Duncan's very useful "Manual of Tramways' Omnibuses, and Electric Railways," you state—"The time has hardly arrived for the publication of an English electric tramway manual, as the number of electric lines, and consequently the number of officials is comparatively small, though we do not doubt that with the development of electric traction, some such directory or handbook will make its appearance. May I be allowed to point out that Mr. Garcke's 'Manual of Electrical Urdertakings,' which is now in its fourth year, contains a section specially devoted to electrical tramways and railways, and I do not think it will be found that a single undertaking, or the names of any of the officials connected with such undertaking have been omitted."

We have not the least wish to underestimate the importance of the work to which Mr. Smith refers. It is undoubtedly a publication of sterling value, which everybody finds of considerable service as a manual of telephone, telegraph, electric lighting, tramway and manufacturing undertakings, and also as a directory of electrical directors. But our reference was to an electric tramway manual, pure and simple, whereas the work referred to contains, as we have indicated, much that is not essential to the tramway manager or engineer.

ELECTRIC LIGHTING NOTES.

Bangor.—A Local Government Board inquiry was held by Col. Slacke on Saturday *re* the Council's application for a £4,500 loan for erecting a dust destructor in connection with the electric lighting station. Mr. Medhurst produced plans of the proposed electric light works and destructor. The destructor, he said, would be a high temperature one, with a forced draught similar to those at Oldham, Leyton, and Llandudno. The destructor would have two cells, each consuming 10 loads a day normally. He expected to develop about 15 to 20 H.P. from the destructor, and as the electric light installation included accumulators, the power developed by the destructor in the daytime would assist in the lighting of the town at night.

Beckenham.—The Local Government Board has sanctioned the electric lighting loan. The British Insulated Wire Company has entered into a contract with the Bromley electricity works whereby the latter will give a temporary supply for the whole of Beckenham until the electricity works are completed. The Beckenham works may not be ready until Christmas or March next. The surveyor is conferring with the Free Wiring Company as to a proposed free wiring contract.

Belfast.—The Electric Committee has accepted a tender of Mr. W. Drennan for wiring the Council Chamber. A deputation from the Electric Committee is to consult with the Public Health Committee as to the utilisation of steam from the proposed refuse destructors.

Bonchurch (I.O.W.).—A public meeting has resolved in favour of the adoption of electricity for street lighting.

Bournemouth.—The electric lighting of the pier, the square, and the Lower Pleasure Gardens, is nearing completion.

Chelmsford.—The Town Council has decided to offer the Chelmsford Electric Lighting Company £24,000 for its undertaking.

Coatbridge.—The proposal to negotiate for the purchase of the undertaking of the Scottish House-to-House Electricity Company comes before the next Council meeting.

Derry.—At a meeting of the Lighting Committee on 20th inst. Mr. Macrory, electrical engineer to the Corporation, submitted his report, which contained statistics as to the expenditure and profits or loss in several English and Scotch cities of about the same size as Derry in connection with electric lighting. After discussion it was decided to have the information contained in the engineer's report printed and circulated among the members of the Council. Councillor McCaul moved:—"That we advertise for a suitable company to provide electric lighting and electric traction for the city if practicable, taking over the public lighting and electric station at a valuation, with all machinery in connection with it, for a period of 25 years." After discussion the motion was lost, the votes being 5 in favour and 6 against.

The British Thomson-Houston Company has laid a proposal before the Council for extending the supply of electricity by taking over the powers and obligations and laying down a system of private lighting. The company seems to be willing that the Corporation should retain and work the present arc lighting plant for street lighting. The company also wants, in connection with the proposal, powers to construct and work electric tramways on the trolley system throughout the city, and the Corporation to support the company's application by order in Council or Act of Parliament for this purpose; the Corporation to also consent to and support the transfer of the existing tramways to the company. The company claim that under their scheme the cost of public lighting to the Corporation would be very considerably reduced. The electric lighting and power supply would be available for the autumn of 1900. The combination of generating stations for lighting and tramways would enable the citizens to obtain electrical energy for light or power at a very low price—unequalled in any place of the size of Londonderry. The letter will be laid before the next meeting of the Lighting Committee of the Corporation for their consideration.

Dorking.—The District Council is in no particular hurry to carry out its electric lighting powers, nor will it allow a company to do so. The Electric Power Distribution Company has made a proposal to light the town electrically, but the Council is replying that it cannot enter into a contract of the kind at present. An argument used against the introduction of electric light is that it would be "manifestly unfair to the Gas Company"!

Dundee.—In a recent statement to the Gas Commission *re* the estimates of the gas department for the present year, Mr. George Ritchie, convener of the Finance Committee, said that the revenue of the electrical department was set down at £10,675 16s. 5d., and the expenditure £10,065 12s. 6d., leaving an estimated surplus of £610 4s. 3d. In Glasgow the capital stood at £1,275,529, and the revenue at £631,644, the percentage of revenue to capital being 49·5, while in Dundee the capital stood at £411,763, and the revenue at £82,790, the percentage of revenue to capital being 20·1. He proposed that the gas rate be fixed at 3s. 4d., and that electricity be supplied at 6s. 8d. for 20 units, at 4d. per unit above 20 units, 3d. per unit above 10,000 units, and that 2d. per unit be charged for motive power. Considerable discussion followed, after which the estimates were adopted.

Fishguard.—The Fishguard Water and Gas Company have given notice to the Haverfordwest District Council that they intend next session to apply for a provisional order authorising them to supply electrical energy for public or private purposes within the parish of Fishguard.

Gateshead.—On Monday a Select Committee of the House of Commons, under the chairmanship of Sir Wm. Houldsworth, considered the Gateshead Electric Lighting Provisional Order. Mr. Moon appeared for the promoters—the Electric Power Distributing Company—and Mr. Littler, Q.C., and Mr. Shaw represented the opponents, the Gateshead Corporation. Mr. Moon said the only point between the promoters and the Corporation was as to what provisions should be inserted in the order. The promoters, in proposing to supply electricity within the borough of Gateshead, had applied to the Corporation under the Electric Lighting Act of 1888. There were meetings between the Corporation and the company, and conditions were laid down by the Corporation which the promoters were perfectly willing to carry out. The only question was whether they should be carried out by provisions to be inserted in the provisional order, or whether they should be carried out by an agreement between the Corporation and the company. The matter had been before the Board of Trade. It was proposed that all matter affecting public interests generally should be inserted in the provisional order, but that all matters affecting individuals such as the cost of motive power, &c., should be the subject of agreement. After some legal argument, the Committee adjourned for the attendance of a Board of Trade official to explain why they objected to the provisions being put in the provisional order. Mr. Pelham, of the Board of Trade, said as the Committee were aware the Board of Trade were given very full powers with regard to provisional orders, and promoters had been obliged to apply to the Board of Trade for provisional orders instead of proceeding by Bill. A model form had been settled after long consideration and deliberation, not only by the Board of Trade but also by the Joint

Committee of Parliament, and the Board of Trade had endeavoured as far as possible to keep the orders uniform, and they were, as a matter of fact, almost uniform. Of course there was some variety as regarded the maximum of price. The Board of Trade did not wish to shut out any improvement in the future, and when some different system had been proved successful by experience, they would certainly be willing to consider an alteration of the provisions which they would put in if asked for in all orders. But as regarded the proposals which he understood the Committee had before them now, the Board of Trade felt that they had had no experience as yet. They felt that there had been no experience as yet whether the coin-freed meter system would succeed, or whether free wiring was a system which should be promoted, therefore the Board of Trade felt unwilling to put these provisions in the order. They had no objection to the promoters making an arrangement with the local authority to provide a supply of energy and free wiring as proposed in the Bill, but they felt that if they were inserted in the provisional order it would become more or less stereotyped, and would be claimed by every other local authority in the future, and the Board of Trade would have to give their sanction to a system which they were not yet convinced would be fair and proper. There were something like 90 orders made that year by the Board of Trade, and nearly as many last year, and in all these cases the orders had been made almost uniform from beginning to end. The Board of Trade did not see anything very peculiar about the circumstances of Gateshead such as to make it desirable that special provisions should be inserted. The order in its present form was settled in 1890, after long inquiry by Major Marindin. He had not seen the proposed agreement.

The Chairman: It could only be revoked by mutual consent?—Yes.

I suppose if the provisions were in the order there would be means of getting out of them?—Only by an amending provisional order.

The Board of Trade feel that it is a new departure, and they are not prepared to acquiesce in this new departure which would be a precedent?—Yes.

Mr. Pelham said that, with regard to the price to be charged for lighting and for power purposes, the Board of Trade had been advised that when the power once entered into private premises the undertakers could not control the use to which it might be put, and consequently they had always, up to now, refused to allow different prices for the light and power. However, he could not press that, because the Board of Trade had departed from it in the case of the City of London electric lighting. They believed there would be some difficulty in enforcing it, but they had allowed them to have the power.

Mr. Littler, Q.C., argued that the Board of Trade had no right to take the position they did, because it was only owing to the undertakers agreeing to these conditions that the Corporation gave its consent. He contended that if the conditions were not allowed, the order should be refused on the ground of want of consent. These coin-freed meters were very common throughout the country, and why should not the Corporation have the opportunity of trying them? Another thing they were very anxious about was the free wiring.

The chairman said the Committee were of opinion that the provisions should be inserted in the provisional order. They thought all Committees of Parliament should pay attention to the advice of the Board of Trade in these matters. At the same time, the matters before them seemed to be matters of small detail, and in that case they could decide in opposition to the advice of the Board of Trade.

The Committee then proceeded to adjust the clauses.

Greenock.—The Secretary for Scotland has consented to the borrowing of £100,000 for the execution of capital works under the Greenock electric lighting order. The engineer has reported to the Electricity Committee, stating that the National Electric Wiring Company proposed to contract with the Police Board for installing the electric light on consumers' premises, in return for which a charge of 1d. per unit is made on all current consumed. The committee recommends the board to enter into an agreement with the company on the understanding that such agreement may be terminated by giving six months' notice.

Heckmondwike.—The District Council have resolved to ask the Local Government Board's sanction to their proposed system for supplying electrical energy, and have instructed their electrical engineer to prepare the necessary plans of the scheme, to enable the Council to apply for borrowing powers.

Hull.—Mr. Barnard, the City electrical engineer, has reported to the Guardians that the cost of lighting the workhouse by electricity will be about £1,000.

Ingleton.—The statutory meeting of the Ingleton Electric Light and Power Company was held on 14th inst., and it was reported that of £4,000 registered capital, about £2,000 had been taken up locally. There were 130 shareholders. As a large battery is advised by the engineers, the initial outlay will exceed £2,500, the amount of the original estimate. It was stated that more capital must be subscribed before the contract could be let, and some shareholders agreed to take additional shares.

Johannesburg.—A contemporary says that the electric lighting installation of the buildings now approaching completion erected for the *Standard and Diggers' News*, Johannesburg, will include two continuous current dynamos of 36-kw. each, made by Messrs. Crompton, also a dynamo to feed 150 lights; a switchboard capable of controlling 20 branch circuits; and boilers, engines, and pumping plant, the whole supplied by Messrs. Davey, Paxman and Co., Limited, Colchester, through their South African representative, Mr. J. W. Logan, M.I.M.E.

Kingston.—To-day (30th inst.) a Local Government Board inquiry is to be held re the Council's £15,000 loan.

Leatherhead.—The Council has received a letter from the English Industrials Company, Limited, making certain proposals regarding the lighting of the district by electricity. A member proposes to move at the next meeting that the Council offer to sell or lease the provisional rights.

Llandilo.—It has been unanimously resolved at this popular Carmarthenshire trading centre, by public meeting, to have the town lit by electric light at an estimated cost of about £1,500.

Llandudno.—At the last Council meeting the engineer reported that all the electricity works' machines were working up to their full load, and in view of the extensions of mains required, and increased number of consumers, it would be wise for the committee to consider the advisability of putting down more plant. Mr. Llewelyn Preece, who was present, stated that his brother (Mr. A. H. Preece) was of opinion that the committee should provide at once for at least 150 kilowatts more, at an estimated cost of £3,000. It was decided to ask Mr. Preece to present a written report upon the subject, taking into consideration the probable requirements of the light railway company, and that he be asked to see Mr. Dickinson, the company's engineer. Mr. Warwick Webb wrote, stating that the directors of the light railway company had decided to accept the terms of the Council for the supply of current for working the proposed railway, and that the company would give due notice as to the date when the current would be required. The Council has asked the directors to give at least nine months' notice as to the date when the current would be required.

Llanelly.—The Highways Committee has decided to defer consideration of the Gas Company's proposal until the committee dealing with the electric light has reported.

London.—Prof. Kennedy, engineer-in-chief to the Westminster Electric Supply Corporation, Limited, has written to the St. George's Vestry with regard to the steam from the Corporation's works emanating from the Vestry's sewers, that he had given instructions to cease the use of condensation entirely at present, further that the new pipes had been completely laid to the canal, but the contractors had not yet delivered the pumps for use with them, so that they could not at present get any benefit from them. In another letter Prof. Kennedy stated, in regard to the complaint about smoke and grit proceeding from the company's premises, that it did not come from their chimney. The Vestry has decided that the surveyor be requested to employ someone to watch the company's chimney.

The Metropolitan Electric Supply Company will apply to the London County Council for their approval to the standard pressure being altered to 200 volts.

The *City Press* of Wednesday stated that Mr. C. G. Algar was to present to the Court of Common Council a report from the Streets Committee on the proceedings which have taken place before the Board of Trade on the subject of the future supply of civic electricity. The committee will recommend the Court to defend the action which is threatened by the City of London Electric Lighting Company unless the company is prepared to make such terms, as regards efficiency and cost of lighting, as will confer greater benefit upon the consumers and ratepayers of the City, and thereby enable any invalidity of such contracts to be removed, if necessary, by a fresh agreement. The committee will also submit a letter from the Board of Trade intimating that they now intend to grant their consent to the additional system of supply by continuous current proposed to be given by the City of London Electric Lighting Company. The committee recommend that the Board of Trade should be asked to further delay giving its approval to such additional system of supply. The committee will bring up a report upon the steps which have been taken to obtain the insertion of all necessary clauses for the protection of the Corporation in the provisional order to the Charing Cross and Strand Electricity Supply Corporation. Notice has since been received of the intention of that company to oppose the Bill with a view to obtaining an extension of the period for compulsory purchase.

Middlesbrough.—The Local Government Board has sanctioned the £36,000 loan for electricity works. The North-Eastern Railway has inquired whether, when, and upon what terms the Corporation would be able to supply current for driving 20 electric cranes which the company proposes to erect at Middlesbrough Docks. After conferring with Mr. Robert Hammond it was found that to supply so large a quantity of power would necessitate doubling the capacity of the works now erecting, also that the Corporation would not be ready to supply for at least 12 months. It is thought that 1½d. to 2¼d. per unit would be the charge. The Electric Lighting Committee is arranging a meeting between Mr. Hammond and the engineer to the railway company.

Monmouth.—At the last Town Council meeting the town clerk read a letter from Messrs. Bramwell & Harris intimating that the contractors could not now make a third turbine similar to the two already working at the same contract price, and suggesting that a second-hand turbine be used, which would require a steam engine, not being made for water-power. The matter was discussed at some length, and it was eventually agreed that the town clerk write Messrs. Bramwell & Harris again, asking them to proceed at once with the construction of a third turbine according to the contract.

Morecambe.—A Local Government Board inquiry was held on 23rd inst. by Colonel Coke into the Council's application for a £5,000 loan for erecting a Beaman & Deas refuse destructor in connection with the electricity works.

Newark.—The Council has received a letter from the Board of Trade with reference to electric lighting, and a committee has been appointed.

Neyland.—The Parish Council have decided to let the question of electric lighting stand in abeyance until such time as they are endowed with urban powers.

Oswestry.—Last week the Council resolved to seal the contract for the purchase of the undertaking of the Oswestry Electric Light and Power Company. The company's managing director, Mr. E. Bremner Smith, has offered to act gratuitously as consulting engineer for a period of five years. Application is to be made to the Local Government Board to borrow £18,000 for purchasing and carrying on the works. Mr. Hawtayne is to report as to arrangements for future working, &c. The company has been requested to purchase no more plant without the consent of the Council.

Rhyl.—The Urban District Council have discussed the desirability of engaging an engineer to advise them as to an electrical scheme, and it has been decided to apply to Mr. Preece for his terms.

Romford.—The District Council is notifying the Rural District Council that it intends including the area of the Romford rural parish in its provisional order to be shortly applied for.

Sheffield.—It is stated that the Brightside and Carbrook Co-operative Society have ordered a complete electrical installation for their Pinfold Lane premises, both for lighting and power. The plant is to consist of a National gas engine, dynamo, and several motors for driving lifts and various machines. The cost of the work will probably exceed £1,500. The Woodhouse Co-operative Stores are now lighted by electricity generated by a small plant on the premises.

Shildon.—The Urban Council has received replies from various firms in relation to an electric light installation, and the surveyor is supplying particulars to some of them, and also asking the Electric Construction Company at what terms they would comply with the district's requirements. He has been instructed to meet representatives of any of the firms who may wish to inspect the district.

Sittingbourne.—The Sittingbourne (Kent) Co-operative Society, Limited, have accepted the contract of Messrs. Stevens and Barker, of Maidstone, to lay down plant for the purpose of lighting the whole of their premises by electricity.

Swansea.—The Local Government Board has sanctioned the borrowing of £52,046 for electric lighting purposes. The further amended plans for the generating station have been approved, and the engineers have been instructed to forthwith proceed with the preparation of the detail drawings and specifications of the works, and to engage a surveyor to take out the quantities for the buildings; the Board of Trade has approved of the proposed system of supply, and the design of the combined lighting and traction poles, and the positions of the same have also been approved.

Tewkesbury.—The Urban District Council has resolved that it is desirable to adopt electric light for the borough, and a committee is inquiring the cost of a provisional order and preparing an estimate as to a scheme.

Walker.—At Tuesday's meeting of the Urban District Council the Electric Lighting Committee reported the success of the Walker Order Confirmation Bill in the House of Commons, and stated that it would be through the House of Lords and ready for the Royal Assent within 10 days from now. The Committee thought that no delay should take place in obtaining a site for electric lighting generator and refuse destructor, and recommended that the chairman, vice-chairman, and clerk be authorised to negotiate with the Newcastle Corporation with the view to obtaining the same. Since the Bill had been passed in the House of Commons a letter had been received from the Tyneside Electric Power Company, enclosing a list of directors, and stating that the company intended to apply for a provisional order authorising them to supply electricity in the Walker district. The Rev. Father Berry, in moving the adoption of the report of the Committee, congratulated all the members of the Council on their victory over the gas company, and on the success of their application for a provisional order, although the company had 50 witnesses and the Council only six. The report was adopted, the application of the Tyneside Electric Power Company not being dealt with, and this concluded the business.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accrington.—There is a deadlock in the negotiations for the proposed sale of the undertaking of the Accrington Tramways Company to the British Electric Traction Company for £55,000, the three Corporations of Accrington, Haslingden and Rawtenstall having agreed upon the desirability of municipalising the lines and refusing to grant any extension of the lease.

Bath.—At a meeting of the City Council on Tuesday it was resolved, on the recommendation of the Electric Light Committee, and on the motion of Alderman Taylor, to oppose the application made by London financiers for an order to institute a system of electric tramway for the city and district. The Council resolved to apply for an order in November, Alderman Taylor explaining that it did not necessarily follow they would lay down the trams themselves. They might dispose of the order, retaining the whip hand. A resolution was passed sanctioning the application for another loan for electric lighting purposes to the amount of £26,000. This sum is in addition to £55,275 already advanced, and covers mainly the cost of extending mains to different parts of the city at present unserved.

Belfast.—The Belfast Mechanical and Engineering Association last week visited the engine works of Messrs. Workman, Clark & Co., Limited. A special feature of these works is the employment of electricity for driving the whole of the machinery, tools and cranes, current being supplied from a central station. The power house contains two large compound engines capable of developing about 500 and 200 H.P. respectively, which drive two dynamos supplying current at 220 volts. A large switchboard occupies one end of the engine room. All the principal shops are divided into sections, each having its own motor.

Berlin.—A novel electric tramway has recently been constructed in Berlin to connect the two offices of the Allgemeine Electricitäts Gesellschaft, in the Schiffbauerdamm and in the Louisenstrasse. The line is an overhead one, the track being carried on brackets attached to the walls of the buildings. It is 200 metres long, and, starting from the first floor of the Schiffbauerdamm, rises at the rate of 1 in 18. The electric tramcar is provided with a motor of 8 H.P., and can attain a speed of 8 kilometres per hour, a rapid means of communication between the two offices being in this way afforded.

Blackheath.—An influential committee has been formed to oppose the proposed scheme of electric tramways across Blackheath, and a petition has been sent to the London County Council setting forth the undesirability of the proposed tramway.

Cheltenham.—The Light Railway Commissioners on 23rd inst. held an inquiry into the application by Mr. T. Nevins for an order to construct a light electric railway from Cheltenham to Cleeve Hill. The line would run from Lansdown through the borough of Prestbury, Southam, and on to Cleeve, a distance of 5 miles 6 furlongs. The estimated cost for a standard gauge line would be £46,500, but as a 3 foot 6 inch gauge has been resolved upon the cost will be materially reduced. It appeared that a covenant of the Pittville Estate (including Wellington Road, over which the line would be laid) prohibited heavy vehicles and the carrying of material through Wellington Road, and the chairman said they could not allow the railway to go through that road. After consultation, the promoter abandoned the portion through the town, and proceeded with respect to the portion from Wellington Road to Cleeve. The Mayor of Cheltenham (Alderman Norman) handed in a memorial containing 3,400 signatures, and gave evidence in support of the scheme, as did others. It was stated in evidence that the inhabitants of Westbury, Cleeve, Woodmancote, and Southam desired the lines. For the opposition it was contended that the intention was to secure a network of rails through Cheltenham, and that the whole of the intention of the promoter ought to be laid before the Commissioners before they gave their approval. A further argument was that the roads through Prestbury were insufficient. The Commissioners will communicate their decision to the promoter and the Council as soon as possible.

Dudley and Stourbridge.—On 22nd inst. there was a trial trip of the electric cars, the power and lighting plants being put to practical tests for the first time. Mr. W. H. Booth, of the British Electric Traction Company, was in charge of the cars, and among the party were the Mayor and some officials of the Dudley Corporation. The lines have yet to be passed by the Board of Trade, but it is expected that they will be opened in about a fortnight or three weeks.

Dundee.—The Tramway Committee has decided that electric power should be applied to the proposed new Constitution Road tramway.

Glasgow Tramways.—On Friday and Monday a Select Committee of the House of Commons, presided over by Mr. A. de Tatton Egerton, considered the Bill promoted by the Glasgow Corporation for powers to construct new tramways outside the borough and for other purposes.

Mr. Balfour Browne, Q.C., for the Corporation, said the only question that would be raised before this Committee had reference to the tramways, in connection with which there was a petition on behalf of the Paisley Tramway Company. The tramways in Glasgow had been extended from time to time outside the city boundaries, and the boundaries had been extended to take them in. What the Corporation now proposed to do was to make an extension from the Halfway House, the present terminus on the Glasgow boundary, through the county of Renfrew, by way of Cardonald and Ralston to the borough of Paisley, and so on to the existing Paisley tramways. The tramways in Paisley were at the present moment the property of the Paisley Tramways Company, but in three years' time they would, under the Tramways Act of 1870, become the property of the Paisley Corporation, and when the Paisley Corporation purchased the tramways they had agreed, by an agreement scheduled in this Bill, to hand them over to be worked by the Corporation of Glasgow in connection with the Glasgow system.

Mr. Walter Paton, convener of the Tramways Committee of the Corporation of Glasgow, examined by Mr. Evan Charteris, gave an account of the tramway system of the Corporation. The districts of

Cardonald and Ralston, he said, were rapidly growing, and stood greatly in need of tramways, and not only so, but there was a large traffic between Glasgow and Paisley, which could only be accommodated by a tramway system. The Corporation had been approached both by the Renfrew County Council and Paisley Corporation, who desired a through service. He considered it absolutely necessary that this agreement and this Bill should be passed now in order that the position might be defined, and Paisley might know what was to be done with the tramways when the right of purchase was exercised.

Mr. John Young, the general manager of the Glasgow Corporation Tramways, gave evidence as to the success of the Corporation in tramway management. The policy of the Corporation, he said, had been to link up with the city the various outlying districts, and he might add that of the 30 miles of streets upon which the tramways were originally constructed, 6¾ miles, or 22½ per cent. were laid in six of the neighbouring burghs. He thought it was admitted by all the parties that hitherto Paisley had been inefficiently supplied with tramways, and he felt confident that the scheme of the Bill was the best that could be proposed in the interests both of Glasgow and Paisley.

Cross-examined by Mr. Worsley Taylor, Q.C., for the Paisley Tramway Company, witness said that no doubt if the Paisley Corporation did not, in 1902, exercise its right of purchase, the Tramway Company would be free to go on for another period of seven years, and could either work the line itself, or hand it over to such a company as the British Electric Traction Company.

Mr. James Mann, shipowner, of Glasgow, a member of the County Council of Renfrew, spoke to the negotiations of that body with the Glasgow Corporation, and the desire of the community in the outlying districts to be connected by tram with Glasgow. Any attempt of the British Electric Traction Company to connect Glasgow and Paisley through Renfrewshire would be approved by the County Council.

Provost M'Kenzie, Paisley, said the ratepayers on various occasions had expressed their dissatisfaction with the present tramway service, and he believed they were practically unanimous in support of the proposal that the Glasgow Corporation should take over and work the lines. Last year the British Electric Traction Company applied for a provisional order empowering them to purchase the existing tramways and to reconstruct them and equip them with electricity provided that the Corporation abstained from exercising their right of purchase for a lengthened period. It was almost simultaneously with this proposal that it was brought to the notice of the Corporation of Paisley that the Corporation of Glasgow had power to lay their tramway lines to within two miles of the boundary of Paisley, and that the Corporation of Glasgow intended to oppose the granting of the order to the British Electric Traction Company. It was proposed then in Paisley that Glasgow might be willing to take over the line and work it, and negotiations with that object were entered into. The Corporation of Paisley came to the conclusion that it was the best thing in their interests that the Corporation of Glasgow should work and equip the tramways.

Mr. Worsley Taylor addressed the Committee on behalf of the petitioners. He submitted that no serious complaint had been made about the present service in Paisley, and that not one word had been said to suggest that the British Electric Traction Company were unlikely to equip and work the line in a perfectly satisfactory manner if they got the opportunity. This Bill virtually empowered the Corporation of Glasgow to buy the Paisley tramways, and he argued that it was never the intention of Parliament that a local authority should be allowed to go outside its own area for such a purpose. Not only so, but if the Bill was passed it would inflict serious hardship upon his clients. They had only enjoyed a short lease of this undertaking and now it was to be taken from them. They were to get for it the price of old iron. Counsel then went at length into the negotiations of the Corporation of Paisley with the British Electric Traction Company. A contract, he said, had been drawn up and adjusted, and all that was wanted to make it legally binding was the seal of the Corporation. He stated that the treatment meted out to the company had been harsh and unjust, and he asked the Committee to show their opinion of it by throwing out the Bill.

After the Committee had deliberated in private, the Chairman announced that they had agreed to pass the preamble, subject to certain conditions. One condition was that the agreement between Paisley and Glasgow should not take effect until the sections of the tramway between Halfway House and the Paisley boundary and between the Paisley boundary and the present Paisley tramways were constructed and in operation. Another condition was that words be added improving the terms of purchase to be found in Section 43 of the Tramways Act of 1870. Improved terms, he believed, had been given in other cases of purchase. Another condition was that the agreement should not be finally valid until confirmed in accordance with Section 43 of the Tramways Act of 1870. The fourth condition was that the promoters should insert a clause similar in effect to clause 25 of the Dundee Act of 1898.

Mr. Balfour Browne said he did not quite understand the second condition.

The Chairman said the Committee were of opinion that the tramways company has had a very hard case indeed, and he believed that in other cases terms of sale had been given which were not so arduous and strict as those in Section 43 of the Act.

On the Committee resuming on Monday, Mr. Balfour Browne, Q.C., for the Glasgow Corporation, read to the Committee the terms of their decision as announced on Friday. His clients had no objection to the stipulation that the agreement between Paisley and Glasgow should not take effect until the tramways between Halfway House and a point inside the Paisley boundary had been constructed, but the Committee said, further, that the Paisley Tramways Company should, in the event of the purchase of their undertaking, get better terms than those of Section 43 of the General Tramways Act of 1870. The Corporation could not see their way to go beyond the terms of this section, nor could they under the circumstances ask a Committee to pass this agreement, making it not finally valid until confirmation according to Section 43, because that would leave Glasgow bound by the agreement while Paisley was free. In all the circumstances, his clients thought the best thing to do was to take this agreement between the Corporations of Glasgow and Paisley out of the Bill altogether, and to take out the confirming clause, and to strike out so much of the preamble of the Bill as related thereto. In this case his learned friends, who appeared for the Paisley Tramways Company with the British Electric Traction Company behind them, would have got all they wanted under the locus which had been granted them by the Court of Referees. There would, therefore, be nothing at all in the Bill referring to the Paisley Tramways Company, and, in fact, the company would have succeeded in their opposition to the Bill.

As the result of some discussion relating to the insertion of the Dundee clause, the Committee intimated that they would not press it.

The other clauses having been adjusted, the Bill, as amended, was ordered to be reported to the House of Commons.

Greenock and Port Glasgow.—At the resumed sitting of the Committee on Wednesday last week, Mr. Forbes Lankester opened the case for the opponents of the Bill. He pointed out that because of certain negotiations that were going on at the time, the Greenock Corporation did not oppose the Bill when it was before the House of Lords, and the chairman of that Committee naturally desired to know why the frontagers should object if the Corporation did not. Now, however, the Corporation was opposing the Bill, and therefore the whole position was altered. It had been pointed out that by the Act of 1893 the Greenock Corporation might employ electricity for the tramways, and that the frontagers had not objected to that Act, but there was much in that Act of which the frontagers entirely approved, and, moreover, to have such a power in the hands of a local authority was a very different thing to having it in the hands of a private company. He would like to point out that the company which was nominally promoting the Bill was not the actual promoter. The actual promoter was the British Electric Traction Company, over whom Parliament had no control. It was obvious, therefore, that the tramway company would be entirely at the mercy of the Electric Traction Company, and on that ground alone he asked the Committee not to pass the Bill. He contended that there should not be electric power in the hands either of the Corporation or of any private company, and if the Bill were rejected the frontagers would use their best endeavours to induce the Corporation of Greenock not to introduce electricity. Mr. C. Forman, C.E., of Glasgow, gave evidence in opposition to the scheme, and said that, in his opinion, it would be extremely dangerous if the trams were run by electricity. At places there was only a distance of 1 foot 8 inches between the rail and the kerb. As a matter of fact, the cars when passing between these places were practically running on the edge of the footpath. The inauguration of electric traction would practically mean the reconstruction of the entire line. He felt assured that the introduction of electric traction would prejudicially affect the interests of frontagers along the line of route. Cross-examined by Mr. Coward, the Witness said he considered that a horse car upon a level road was more under the control of the driver than an electrically-driven car. Mechanical power was a force which might get out of a man's control, and if it did, it was very dangerous in a crowded street. Evidence was then tendered by frontagers in opposition to the Bill, after which the Committee again adjourned.

The Committee met again on Thursday. Mr. Fitzgerald, in the course of his examination of Mr. John Young, the general manager of the Glasgow Corporation Tramways, raised the question of an agreement between the Corporation of Greenock and the National Telephone Company, which agreement he said removed all difficulty on the part of the Corporation in introducing electric traction if it acquired the tramways. After argument by counsel, the Committee however, decided not to receive the agreement.

Mr. Balfour Browne said that he had no objection to the agreement being put in, as he thought the case of the company was strong enough without taking the technical objection.

The Chairman stated that the Committee had been considering the matter very carefully, and whilst he adhered to his decision, it was not an agreement which could properly, according to the custom of these rooms, be brought before the Committee. He thought also that the Committee had been kept very much in the dark, and that the agreement, if it were intended to bring it up, should have been brought before. Still, he considered both in the interest of the public, and in the interest of all parties, it was better that the agreement should be brought into the case.

Mr. Fitzgerald said he was obliged to the chairman, but he regretted that he should think there was any intention whatever of keeping the Committee in the dark. There was no intention of the kind.

The Chairman said he did not think he implied any intention on the part of the counsel, because counsel said that the agreement had only then come into his possession, but the parties instructing him must have been aware of it.

Mr. Fitzgerald added that he should be very sorry if the Committee thought that either the counsel who appeared for the Corporation or the gentlemen who instructed them had any intention of misleading the Committee or keeping them in the dark. The moment the question was raised it was inquired into and this agreement was found, and when it was found he endeavoured to have it put in by his witness.

Mr. John Young was then called, and Mr. Fitzgerald read to him the leading points in the agreement. The agreement, he said, set

forth that the National Telephone Company were desirous of placing their telephone system within the Burgh of Greenock, on the twin-wire or metallic return principle, and towards this end it was essential that the main routes of wires and other works should be placed underground, and the Board of Police had consented to give permission to place the telephone system on the twin-wire or metallic return principle. The agreement, he might say, had two dates, one March 24th and the other June 28th of this year. He did not understand why an agreement should have two dates. Continuing, witness said he was informed the dates were the dates when agreement was executed by the respective parties. The agreement went on to say that the powers conferred on the Telephone Company by this agreement should in no way enable them to interfere with the rights of the Board of Police to use gas or electricity or electric energy for purposes of lighting, motor power, tramways by electric traction or otherwise, and there should be no right on the part of the Telephone Company for an interdict, or to claim damages in respect to leakage, induction or otherwise, arising from any future undertaking of the Board of Police.

Mr. Young said he had read the agreement, and he had no hesitation in saying that with it the Corporation of Greenock would be perfectly able to introduce electricity into the tramway system when and if they acquired it.

In cross-examination, the witness said that in the case of Glasgow he believed it was true that no contractor was prepared to run the risk of the National Telephone clause. He had only read a portion of the agreement, and could not say that the consideration given by the Greenock Corporation was that the National Telephone Company should be allowed to break up the streets of the burgh to lay their mains. He did not approve of people being allowed to break up the streets of a town. It was obvious, of course, that the Corporation of Greenock could not give the National Telephone Company power to break up the streets, either of Port Glasgow or Gourock. He considered that this tramway system should be equipped with electrical power.

Other witnesses having been examined in opposition to the Bill, the Committee, after a short deliberation, passed the preamble of the Bill, with certain modifications.

On the Committee meeting to consider the clauses of the Bill, Mr. Moon, for the Greenock and Port Glasgow Tramways Company, the promoters, presented a proviso for insertion in clause 4, a clause which deals with the adoption of electric traction for the tramways. The proviso was in the following terms, viz. :—"Provided that save so far as the Greenock Board shall assent thereto, nothing in this section shall be deemed to authorise the company to enter upon or break up the tramways within the borough of Greenock for the use of electrical power thereon." The Committee accepted this proviso, and it was inserted in the clause. Mr. Moon presented the following proviso for insertion in the clause empowering the company to erect a generating station, viz. :—"Provided that the powers of this section shall not be exercised until the Greenock Board shall have consented to the use of electricity by the company on the tramways within the borough of Greenock, and shall have refused or neglected to supply upon equitable terms such electricity as the company may require for use on the tramway." This was agreed to. The next clause discussed was clause 18, which, as it stood in the Bill, read as follows:—"In the event of the Greenock Board determining to purchase the tramways of the company, they shall at the same time, if so required by the company, purchase all engines, dynamos, batteries, accumulators, mains, wires, posts, plates and other apparatus, works and appliances of the company suitable to and used by them for the purposes of the tramways so purchased, or of any other tramways for the time being worked by the company in connection with the tramways so purchased." Mr. Moon suggested the addition of the following proviso, viz. :—"Provided that if the Greenock Board contend that any of such engines, dynamos, batteries, accumulators, mains, wires, posts, plates, or other apparatus and appliances which the company may require the said Board to purchase under this section are not suitable to or used by the company for the purposes aforesaid, it may, on their application, be referred to arbitration of an engineer under and according to provisions of the Arbitration Act, 1889, to determine whether or not same are such as ought to be purchased under this section." After considerable discussion the Committee decided not to alter the clause. Mr. Kennedy, Parliamentary agent for the Greenock Board of Police, asked the Committee to incorporate in the Bill parts 2 and 3 of the Tramways Act of 1870, which would give the Board protection in regard to gas and water mains, sewers, &c., in connection with the reconstruction of the tramways for use of electrical power. Mr. Moon, for the tramways company, stated that the Greenock Corporation did not require their protection, which the Corporations of both Gourock and Port Glasgow were content to do without. The Committee decided to incorporate parts 2 and 3 as desired by the Greenock Corporation.

Mr. Forbes Lankester, for the National Telephone Company, asked for the insertion of a clause to protect the company from physical interference as distinguished from electrical interference. The clause was inserted with some amendment. The remainder of the Bill having been adjusted, it was ordered for report to the House.

Hull.—Satisfactory trials of the new Corporation electric tramway service were made on the Hessle Road section at Hull on Tuesday, the chairman of the committee (Ald. Larard) being accompanied by Councillor H. Skinner, chairman of the Electric Lighting Committee, and other members of the Corporation. At present there are 30 motor cars in hand, and about 30 "trailers," which can be attached to the cars in case of extra pressure of passengers. From four to five miles of the newly-constructed roads will be opened for traffic next week, the fare from point to point of each section having been fixed at 1d. per passenger. The Anlaby Road section, which leads past the ground on which the Yorkshire Agricultural Show is to be held, will be opened for traffic the week after next.

Huddersfield.—The Council has resolved to apply for Parliamentary sanction for borrowing funds to enable the borough engineer's electric traction scheme to be carried out in such sections as may be determined; also for various powers regarding the construction and working of tramways outside the borough. The borough engineer has been authorised to obtain the opinion of Mr. H. F. Parshall upon the plans and specifications prepared by him.

Isle of Man.—On Tuesday and Wednesday the arbitrators appointed by Lord Henniker, Lieutenant-Governor, were engaged at Douglas in considering a claim of £7,500 compensation for depreciation in the value of land and property by the construction of the Laxey and Ramsey electric tramway just opened. Leading counsel were engaged, and professional gentlemen from England retained as witnesses. The tramway company resisted the claim, and made no offer, being willing to abide by the decision of the arbitrators. There are about 35 other claims for damages to be made against the company.

Kirkcaldy.—The Town Council has received letters from syndicates anxious to take over the tramways and electrically equip them.

Light Railways.—The Hampstead Vestry will oppose the Finchley, Hendon, Edgware, and District Light Railways (Electric) scheme, which has been re-introduced by the promoters.

The London United Tramways.—After several years of contest for the adoption of the overhead system of electricity on its tramways within the district of the London County Council, the London United Tramways Company has at length succeeded. Last year, says the *Financial News*, the company obtained these powers for all its lines in the county of Middlesex, and on 23rd inst. the Bill to authorise the overhead system within the county of London passed the House of Commons unopposed. As part of the arrangement with the London County Council the company has agreed to lay a short piece of underground system between Hammersmith Broadway and Young's Corner, Chiswick; but on the two lines which converge on the terminus of the Central London Electric Railway, and, indeed, on the whole of the company's main lines, the overhead system will be used. The process of construction is proceeding rapidly, and now that the only obstacle is removed, the whole of the United Company's system will be operated by electricity. The existing lines have been reconstructed, and some miles of the extensions from Kew Bridge to Brentford and Hounslow are already laid, so that the opening of the first electric tramways in London will be completed at an early date.

Newport.—Mr. Robert H. Haynes, borough engineer to the Newport Corporation, has issued an exhaustive report on the Newport tramways, with special reference to the proposed adoption of electric traction. The report comprises 32 foolscap printed pages, and is in two parts. Part I. is chiefly historical. Part II. deals with the application of electricity to the working of the lines. The writer deals with the various systems of traction, viz., (1) by accumulators, (2) by underground conductors, (3) by surface contact, and (4) by overhead wires. He concludes that the first-named system is a financial failure, the conduit system is unsuitable to the physical conditions met with at Newport, and the surface contact system is not reported on favourably owing to the risk of failure and accident and also the cost. He comes to the conclusion that the overhead system is the best and cheapest. He recommends span wires throughout, they being suspended from side poles in some streets, and from rosettes attached to the buildings in others. He says that the introduction of transforming apparatus at the lighting station, with a view to utilising the present machines for traction work, would be attended by many complications and risks of breakdown, and the electrical and commercial efficiency of the combination would be very low. He details in the report various extensions and alterations which might well be introduced to the existing tramway system which would cost £51,280, and the cost of overhead electrical equipment calculated at £1,750 per mile (single track) would be £20,811. The total expenditure on the completed system, including track and overhead line work, but excluding power station generating plant, car equipment, sheds and workshops, would be £107,370, and £5,122 would have to be set aside annually for interest and redemption. Mr. Haynes goes at considerable length into the question of single v. double-decked cars, and he says that the single-deck car seems to be obligatory at Newport, but such a type should be selected as will cater to some extent for the top seat pleasure traffic. Where local conditions do not prevent its use the double-deck car is certainly the best, the California combination car, a modification of which is now in use on the Liverpool Corporation tramways, being classed next in order of merit by Mr. Haynes. A 34-car equipment would require 525 H.P. generating plant; three 270-H.P. engines (two in constant use and one for reserve) would probably be suitable, but it would be wiser to instal 300-H.P. sets. Mr Haynes seems to favour municipal ownership of the lines, and their being worked by a company. The current consumption is put down at 603,000 units per year, which at 2d. per unit for 400,000, and 1d. beyond, makes a revenue of £4,179 per annum for the electricity undertaking if the two concerns are worked as a joint undertaking but under different committees, but as we have said, Mr. Haynes suggests that municipal working would not be advantageous.

(*Continued on page* 1073.)

ELECTRIC LIGHT AND TRACTION ENGINES.

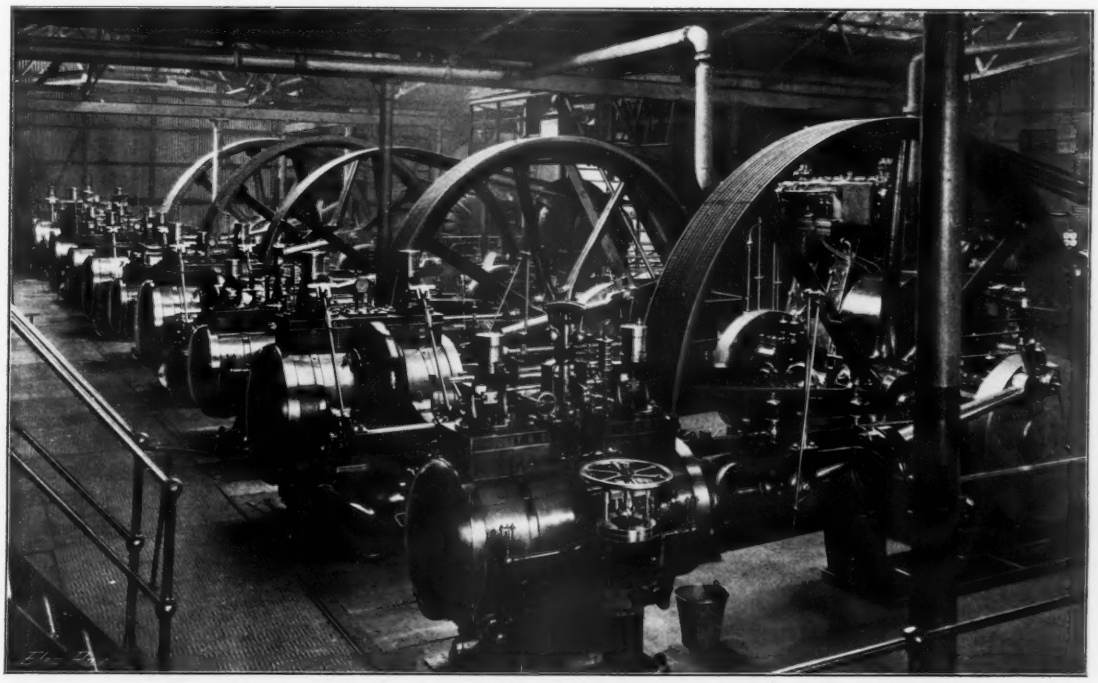
II.

In our first article on this subject we endeavoured to show that English engine makers are quite able to satisfy the requirements of English electric tramway undertakings, thereby obviating the necessity for placing future orders abroad to the same extent as has been done in the past. Our reference was more particularly made to the general design, efficiency, and fitness of English engines, although we do not ignore the importance of the time element. We believe, so far as lighting stations are concerned, that the principal cause of foreign-made engines being installed has been the extreme difficulty that has been experienced in getting delivery from home manufactories with the required expedition. But by means of extensions and the adoption of other measures, English engineering firms have been re-arranging their works with a view to keeping the quick-delivery orders for home execution. The supply has not, we believe, for some time past kept pace with the demand. Our factories have an enormous foreign and colonial trade which has to be attended to, and bearing in mind the greatly increased home demand and growing foreign business, works extensions have not been carried out so speedily as they perhaps should have been. However, we suppose the engineering strike congestion has been nearly worked off by this time, and with larger works capacity our makers should now find it easier to keep pace with current orders.

Our inquiries among English firms have shown distinctly that there is a strong feeling existing among them that foreign engines are quite unnecessary, but at the same time they are doing well, for the books are full of orders for a long time to come. One leading firm is so occupied with several months' arrears of orders, that it finds it impossible to devote time even to a bare consideration of the American *v.* English controversy.

The opinion of another leading firm of engine-makers, Messrs. Robey & Co., Limited, is that if England is ever beaten in the race by America, it will not be through lack of either enterprise or ability, but merely because England is the smaller country, with a lesser population. Though England may be beaten in quantity, she will always hold her own so far as quality is concerned. It is interesting, as showing the advance that is being made in the quantity of work to be done, that Messrs. Robey & Co. are now turning out nearly double the engine H.P. that they did five years ago, their output last year being not less than 65,000 H.P., a very large proportion of which was for electric lighting and power distribution. Great as this output is, it is expected to increase largely year by year.

We give several illustrations showing some specimens of engine manufacture carried out by Messrs. Robey. Fig. 3 shows a Robey coupled cross compound engine, with alternator mounted directly on the engine shaft, as supplied to the Corporation of St. Helens. This set is capable of generating 115 kilowatts when running 100 revolutions per minute, the voltage being 2,000. The engine and alternator are mounted on a massive iron base-plate, the whole forming a very rigid and substantial job. Continuous lubrication is fitted to all the working parts. The steam consumption per kw.-hour is 26·9 lbs., the steam pressure being 120 lbs., vacuum 25 inches.



Electric Light and Traction Engines.—Fig. 1.

In fig. 1 we show an interior view of the electricity works of the Newcastle-on-Tyne Electric Supply Company, Limited, with a number of Robey coupled compound Class E engines, the alternators being rope-driven. The total H.P. developed is 1,800, and the voltage 2,100. We understand that the steam tests gave 15 lbs. per I.H.P., with 20 inches vacuum and 120 lbs. steam pressure.

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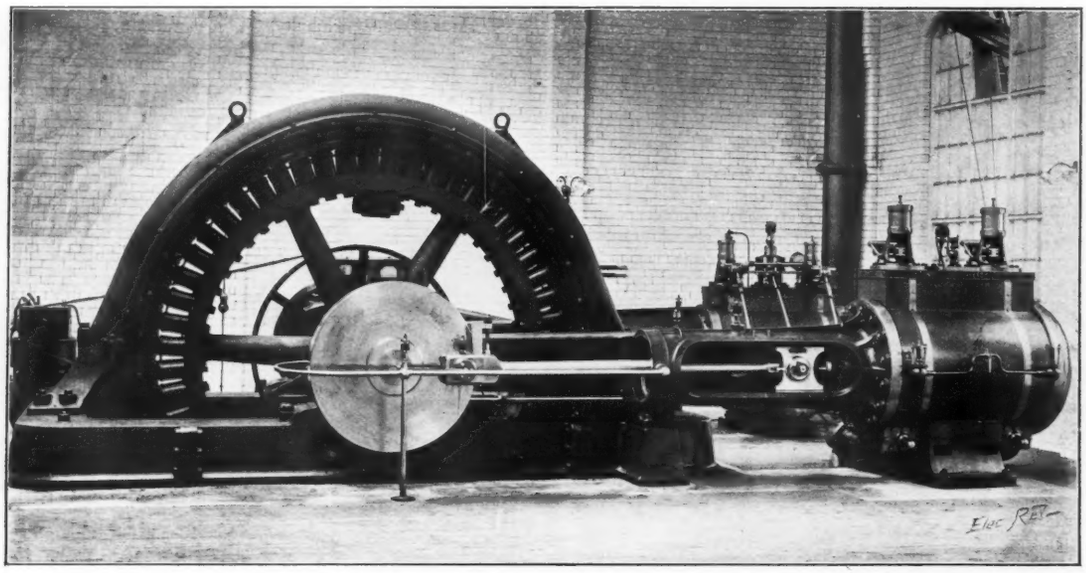
In fig. 2 is shown a similar type of engine coupled direct to two-phase alternator capable of generating 200 kw., and supplied to the North-Eastern Steel Works, Middlesbrough. The voltage is 2,000.

Another firm, Messrs. Ernest Scott & Mountain, are building a large number of compound enclosed double acting engines, with their improved system of forced lubrication, for lighting and traction work, and they have in hand at the present moment for the Great Northern Railway Company, of Ireland, for the Hill of Howth Electric Railway, three sets of engines and dynamos, each set consisting of a compound enclosed self-lubricating engine of 250 I.H.P., the engines running at a speed of 380 revolutions per minute, and coupled direct to four-pole continuous current generators, constructed to give an output of 125 kilowatts at an E.M.F. of 500 volts, but the dynamos are capable of running up to 600 volts by over-compounding.

An engine of the type referred to, but coupled direct to continuous current two-pole dynamos, has been recently supplied to Messrs. Charles Cammell & Co., Limited, Sheffield, for driving travelling cranes, and a fine specimen of the same kind was illustrated in our issue of June 9th, as employed for work at a North country ironstone mine.



Electric Light and Traction Engines.—Fig. 2.

The engines are of the side by side compound type, with a central valve worked by one eccentric and rod, admitting steam to the high and low pressure cylinders, the cranks being placed opposite and therefore balanced, the moving parts being made as nearly as possible to the same weight. The engines, being double-acting, are extremely economical and efficient, and we understand that in some recent tests of combined engines and dynamos the efficiency has worked out as high as 89 per cent. between the I.H.P. of the engine and the electrical output of the dynamo.

Messrs. Scott & Mountain are making a speciality also of multipolar dynamos for coupling direct to this type of engine, the dynamos being specially suitable for traction work. The armatures are slotted and the conductors laid in the slots, and their special system of winding is adopted, by which all connections are extremely accessible, facilitating very ready repair in case of accident. The machines are, as a rule, made with parallel wound armatures, the commutators being of large diameter, and fitted with a large number of sections. Carbon block brushes are used for collection.

Messrs. Scott & Mountain are manufacturers of both the engines and dynamos, and they claim to be in an exceptional position to give satisfactory delivery. They have also a complete testing plant at their works, so that the machinery can be thoroughly tested before leaving.

THE GENERATION OF POWER FOR ELECTRIC TRACTION.

By J. GRAY SCOTT.

(*Continued from page* 964.)

Combined lighting and traction stations may exist under various conditions:—

1. The lighting system may be low tension continuous, at such a voltage as to admit of interchange of the identical units between lighting and traction circuits respectively.

These are, of course, the most favourable conditions under which the combination may be made, and it may be mentioned incidentally that this system obtains at Bradford, whose station has proved a pioneer in this and other important innovations.

It is interesting to note, moreover, that many modern stations are being designed on similar lines, in order to anticipate the supply of power for tramway traction, which, as already pointed out, proves of considerable value in the early history of a small station.

The lighting in Bradford is on the three-wire system, the voltage across the outers being 460.

The larger units are run across the outers at or about this voltage, and balancing machines are also run on either side of the system.

Simultaneous supply (from the same machine) for traction and lighting is obviously out of the question—the negative being earthed in the former case—and in order to effect an interchange a two-way switch is employed. The requisite voltage for traction (500—550 volts) may be obtained by increased speed, increased excitation, or what is equivalent, the addition of series coils on the field magnets, which are cut out when the machine is on lighting supply.

Details of this interchange will be dealt with in another section.

2. The lighting system—though low tension continuous—may be at a voltage unsuitable for traction work, and under these circumstances direct interchange would not be possible.

In a case of this kind it would be desirable to lay down separate plant; but if the voltage of the lighting supply were at or about 250, two machines could be coupled in series, a method which might prove of service as a temporary measure.

At Blackburn, for example, the generator armatures have

two distinct windings, connected at each end to their respective commutators.

By means of a two-way switch these windings may be connected in series or parallel, when the generator is required for traction or lighting respectively.

3. The lighting system may be high tension continuous, as first laid down at Oxford, and subsequently known as the "Oxford system."

The station pressure is generally 1,400—2,000 volts, and feeders are laid to various sub-stations, equipped with suitable motor generators or continuous current transformers, which, in turn, feed the distributing system at a pressure of 100 or 200 volts.

The supply of power for trams could be easily arranged by installing the necessary number of additional transformers, of size and design to give a convenient output at 500 volts.

Such an arrangement would at once be effective in increasing the output of the station, and its load factor; but the author is not aware of any case in which such a scheme has been put into practice.

There are some seven stations equipped on this system, and as satisfactory working seems possible for lighting supply, there is no reason why an extension of the scheme to include the supply of power for tramways should not be successful, provided the former be unaffected by the sudden fluctuations of load associated with traction work.

By uncoupling the engine, the remaining machines are available for the functions of motor alternator as before.

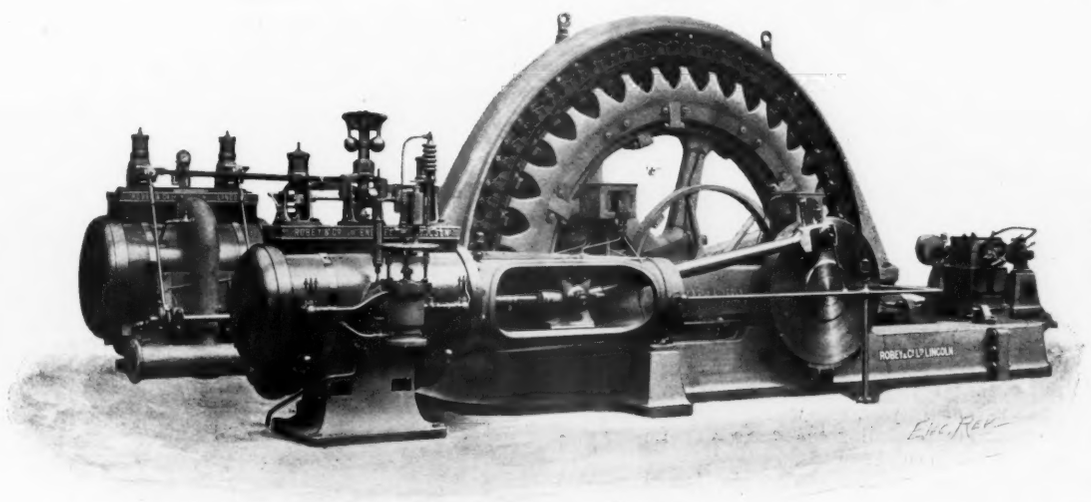
We have reviewed the principal systems on which central supply stations are worked in this country, and referred to each system with respect to the acquisition of a tramway load, but it must be borne in mind that in some cases, where the conditions of supply are otherwise suitable, it might not, for other reasons, be judicious to combine the undertakings.

A case in point is that of Glasgow. There are at present running in Glasgow over 400 cars, all worked by horses with the exception of a short line experimentally equipped for electric traction and running about 30 cars.

A recent report supplied to the Corporation by Mr. Horace F. Parshall, in favour of electric traction, has been adopted in its entirety, and it is anticipated that within the next two years the conversion from horse to electric traction will be completed.

Mr. Parshall, however, does not favour a combined station, and in this, no doubt, is perfectly consistent, for in consequence of the magnitude of the scheme, the large area to be served, and probable great increase in traffic, he has recommended the adoption of multiphase transmission.

This renders necessary the installation of special machinery, and at once precludes the possibility of one of



Electric Light and Traction Engines.—Fig. 3.

4. The lighting system may be high tension alternating.

Owing to the non-existence, up to the present, of suitable motors either for cars or for rotary converters, such a system, as usually laid down for town supply, is out of the question for tramways.

It is usual, therefore, to instal separate plant, and this has been done at such stations as Blackpool, Dover and Halifax.

An additional feature of the last-mentioned station is its large battery of accumulators, the primary objects of which are to provide a steady and economical load for the tramway plant, to prevent undue fluctuations of the voltage on the line, and to supply the necessary power at times of light load.

The battery is also requisitioned through the medium of a motor alternator for the all-night load supply of the lighting system.

In a recent paper before the Municipal Electrical Association, Mr. J. H. Rider presented a similar scheme.

Mr. Rider proposed to arrange a steam engine, a continuous current dynamo, and an alternator mounted on one bed plate and common shaft coupled throughout.

The duties of the two machines are practically the same as those referred to above, but in addition, either or both may be driven by the steam engine.

Such an arrangement is obviously conducive to economical working of the engine, which may be maintained at or about full load by employing the continuous current machine for cell charging.

the principal advantages to be gained by a combination of the lighting and traction systems, viz., interchangeability of plant.

While no one would think for a moment of disputing Mr. Parshall's authority as a tramway expert, it may be mentioned that other eminent engineers are not at one with him in every respect.

Mr. C. H. Wordingham, city electrical engineer to the Corporation of Manchester, has recently reported on the subject of tramway traction to his Council.

Regarded as cities, Manchester and Glasgow have several points of similarity, and their tramway schemes are probably of about equal magnitude. But Mr. Wordingham has favoured the combination of lighting and traction—so far, at any rate, as the supply of power is concerned.

There is not the slightest doubt that both these experts have drawn up their respective schemes on sound bases, and each is prepared to carry it through.

From what we know of the abilities of both Mr. Parshall and Mr. Wordingham, we can safely say that both schemes will prove successful, but in consequence of the large amount of discussion which the matter has entailed, not only in Glasgow and Manchester—but in municipal and electrical circles generally—the carrying out of these schemes and their subsequent working results, will present an aspect of more than passing interest.

The necessity for stand-by machinery in a lighting station,

in order to cope with the maximum demand throughout the year is familiar to all conversant with central station working, and when this stand-by plant is supplemented by that desirable for breakdown contingencies, the proportion of total plant installed which must simply be held available, becomes very large.

A tramway load is, of course, regular in comparison, not only throughout each day, but throughout the year, and it is not necessary to do more than provide the power required for the total number of cars running, which does not greatly vary from day to day.

The maximum for each day generally occurs in the case of city tramways at the close of the business day, and the nature of the load curve is practically the same for each day throughout the year, whereas the lighting peak moves with the seasons so to speak, increasing in height and occurring earlier in the day as winter approaches.

There is, therefore, for perhaps a month or two throughout the year, a daily concurrence of peaks on the lighting and tramway load curves respectively, but the peak in the latter instance is by no means so prominent, and should not represent a demand beyond the capacity of the plant used daily for power supply, in which provision can easily be made to meet abnormal demands.

Let us likewise consider the respective load curves for a complete year—plotted, say, from weekly returns of units delivered.

On the lighting curve—the maximum usually occurs about midwinter, but, generally speaking, we may say that the summer traffic gives us the maximum on the tramway load curve.

As in the case of the daily curve, the precise nature of the curve extending over a year, is largely dependent upon local conditions, and is subject to certain fluctuations. Thus, the power consumed per car after a heavy fall of snow is sometimes excessive, and of course increased traffic results from inclement weather. This increase in traffic, it should be noted, is often more apparent than real—being largely confined to inside passengers.

Considering again an ordinary lighting load curve, it may be said that as a station develops—that is, as the number of ordinary consumers increases—the peak becomes higher in proportion, while the remainder of the curve is practically unaffected.

As part of the machinery is used for so short a proportion of time throughout the year, may we not consider such plant as *stand-by*, and as precluding the necessity for further provision for breakdown contingencies.

In the case of a combined station, with interchangeable units, this plant would be available for either lighting or traction, and while admittedly, the inclusion of tramway supply necessitates additional machinery, it does not, in the author's opinion, involve simultaneous laying down of spare plant, as would certainly be desirable in the case of a station in which interchange is not possible.

During the past year we have, in Bradford, shared the inconvenience experienced in many towns through late delivery of plant, traceable, no doubt, to the recent trouble in the engineering trade; and though not in the unfortunate position of one or two other towns, it was only with difficulty that the maximum demand could be met.

The facility for interchange, however, proved most convenient, because machinery which was fully loaded over the peak was available during the day, and could be run on traction supply, while any desired examination or repairs might be made on the set ordinarily employed for this purpose.

The author admits, of course, that a breakdown involving disablement would not, under these conditions, be provided for, but breakdowns of this nature are fortunately exceptional, and the principal which he desires to emphasise is that of *a stitch in time*.

Presuming, however, that ample provision is to be made for such contingencies by installing spare plant, the fact remains that plant so installed is available for either traction or lighting, a simultaneous breakdown being highly improbable, and thus the *duty* of the spare plant is very materially increased, and the plant required as stand-by is reduced by one-half.

Such an advantage, as already pointed out, does not accrue if the units are not interchangeable, it being then necessary to provide additional plant of both types, or risk discontinuity of supply for a greater or less period of time—a most undesirable state of affairs indeed.

The author considers, however, that the combination, even where distinct plant is employed, presents certain advantages, particularly in small stations.

Though the lighting machinery and its load remain distinct and unaffected by the addition of plant for power supply, the cost of production of power should be considerably less than would be possible from a separate power station, because the combined station may be worked by practically the same staff, and, as already pointed out, would save a large proportion of building and equipment expenses.

To the author's mind, an alternating station would benefit greatly by the acquisition of a tramway load, being then in a position to supply continuous current for motors from the tramway mains, and thus secure, indirectly, the desirable day load, for which purpose alone the laying of mains would not be justifiable from a financial point of view.

(*To be continued.*)

COMMUTATED CURRENT WAVES OF ALTERNATORS.

THE *Transactions of the American Institute of Electrical Engineers*, Vol. XV., contains a paper by Mr. Dugald C. Jackson on the commutated current wave of a composite wound alternator.

The alternator experimented on was an old 50-kilowatt

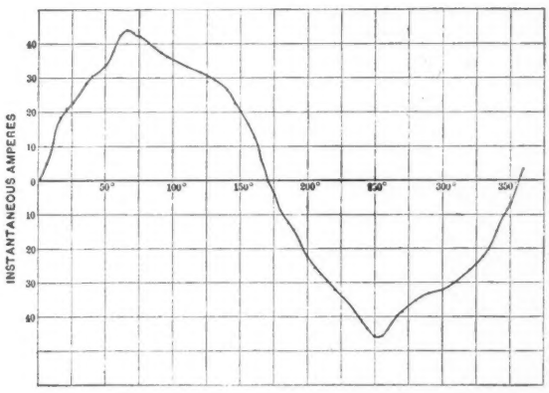


FIG. 1.—External Current Wave with Load of 24 Amperes.

Thomson-Houston machine, giving a normal pressure of 1,100 volts at a frequency of 125 alternations per second. The points on the curves were determined by a balance method, the points of balance being indicated by a portable form of capillary electrometer; this instrument being

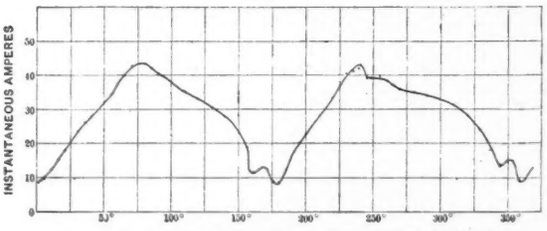


Fig. 2.—Commutated Current Wave with Variable Load averaging 24 amperes.

superior as regards convenience, accuracy, and speed of making observations to a galvanometer or telephone receiver.

A comparison of the external current waves with the commutated waves—we reproduce two such waves—shows that the commutated waves have practically the same form

as the original waves of current (with alternate loops inverted), except in regions occupying about 25° on either side of the zero points of the original waves. Within these regions the commutated waves do not come to zero, and they take a characteristic toothed shape, as is to be expected from the effect of the self-induction of the field windings when they are short-circuited by the brushes on the commutator.

Mr. Jackson's paper should be of use in throwing some light on the action of rotary converters. There is generally considerable difficulty in obtaining sparkless commutation in rotary converters, and the defect can only be overcome after thoroughly understanding the various reactions within the armature.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 1068.)

Leeds.—Sir Francis Marindin, on behalf of the Board of Trade, has inspected the Headingley electric car route. He was accompanied by the chairman of the Tramways Committee (Mr. Smithson), the chairman of the Highways Committee (Alderman Hannam), the tramways manager (Mr. W. Wharam), the consulting electrical engineer (Mr. E. Talbot), the tramways engineer (Mr. J. Burbridge) and the highways surveyor (Mr. T. A. Prince). During this week a service of horse cars is to be run, but probably after Saturday they will not run again to Headingley until the close of August or the beginning of September, by which time it is anticipated that the new engines will have been fixed at the generating station.

Manchester.—The question of underground *v.* overhead traction will be raised at a meeting of the Tramways Committee next week, when a proposal will be made to send a deputation to America to study the working of the tramways there, with a particular view to comparing the overhead and underground systems of working.

Niagara Gorge Railroad.—The Niagara Gorge Railroad Company has been incorporated, and has become the successor of the Niagara Falls and Lewiston Electric Railway Company as owners of the beautiful excursion route through the Niagara gorge. The capital stock of the new company is $1,000,000, divided into 10,000 shares each of $100. The Niagara Gorge Railroad Company has acquired all the capital, stock, franchises, plants and equipment, not only of the gorge road, but also of the following companies, which the defunct company owned and operated:—The Niagara Falls Tower Company, the Buttery Whirlpool Rapids Company, the Niagara Rapids View Company, and the Niagara Whirlpool Rapids Elevator Company. Trips will be made down through the gorge, over the gorge route to Lewiston, across the new suspension bridge at that point to the Canadian side, and up over the Niagara Falls Park and River Railway to the Dufferin Islands, and then across the upper arch to Niagara Falls. The road resumed operation on Sunday, June 4th.

Plymouth.—The proposal of the Corporation to equip the Compton section of the municipal tramways for electric traction was the subject of an inquiry which was held on Thursday last week by Major Cardew, of the Board of Trade. The sum proposed to be borrowed is £18,000, and the equipment is to be the same as that of the Prince Rock section, which is now approaching completion. Major Cardew expressed the opinion that the Board of Trade would not allow as long a period as 30 years—which the Corporation asked—for the repayment of the loan. The town clerk pointed out that Parliament had given them 30 years for similar work, and said it was the practice of the Corporation as well as to their interest to keep the lines in thorough repair.

Portrush.—The Urban Council is to meet the Giant's Causeway and Portrush Electric Tramway Company on the subject of the trolley poles now in position along certain roads. At the last Council meeting a great deal of objection was raisd to them as obstructions.

South Staffordshire.—Since the failure of the Bill promoted by the South Staffordshire Tramways Company and the British Electric Traction Company, considerable anxiety has been shown by the various local authorities concerned as to the position in which they now stand respecting these companies. There has been so much cutting and carving, so much agreement and disagreement, that it is difficult to unravel the actual state of things, more especially as the British Electric Traction Company is pushing forward what little remains of its depleted Bill. From time to time there have been recorded in the Electrical Review the arrangements made with the local authorities and the company, and so far as can be gleaned, the actual position of affairs now is something like the following:—The Corporation of Walsall and Wednesbury, and the Urban District Council of Darlaston, have agreed upon a united policy for purchasing and working the tramways in their respective districts jointly. The Corporation of West Bromwich will purchase the whole of the tramways running through the borough—about 12 miles of single track—and it may work them alone or jointly with other local authorities. The Urban District Council of Handsworth, it would appear, has not decided to purchase or to join with any other authority and it with Tipton will be in the hands of the South Staffordshire Tramways Company, which might lease to another company. It should, however, be pointed out that in Handsworth there is only half-a-mile of tramlines, but it is the connecting link in 20 miles of tramways between towns in South Staffordshire and Birmingham. It is stated that the South Staffordshire Tramways Company is indignant that the British Electric Traction Company should go and treat with certain local authorities with the prospect of wiping out the South Staffordshire Tramways shareholders altogether.

Southend and Leigh.—The other day Sir Courtenay Boyle heard the objection of the Leigh Urban District Council to the confirmation of the order for the making of about six miles of light railway in Southend and the Leigh Urban District. The Corporation of Southend were the promoters, and the Urban District Council wanted the Board of Trade to insert a clause binding the promoters to widen a road to a *minimum* of 23 feet, and to complete the whole of the light railway within three years. The Corporation objected to widening the road for the benefit of the Urban Council, especially as that Council could, at the end of 10 years, take over the light railway. Sir C. Boyle said it was a strong thing to go into another local authority's district without their consent, but at the same time the Corporation were justified in resisting the claim of the Urban Council that they should pay for the widening of the road. He, however, should adjourn the case for the parties to come to some agreement.

Southport and Lytham.—The promoters of this tramway scheme are not going to be content with the refusal of the Parliamentary Committee to sanction the construction of a tramway with a conveyor bridge across the Ribble estuary. They are taking power to construct the No. 1, or Southport section, the only portion sanctioned by the committee, but it is scarcely likely, says the *Liverpool Post*, that they will make any start with the work until they are able to carry it right through. They propose, therefore, to bring in a new scheme, which, it is anticipated, will meet the objections raised by Preston and Lytham.

TELEGRAPH AND TELEPHONE NOTES.

Australian Landlines.—We learn from the Australian Press that the work of erecting a second telegraph wire to Port Darwin is advancing rapidly, but in the Northern Territory operations have been much delayed by the wet season. It is expected that the line from Adelaide to Barrow's Creek will be ready by the end of June, and probably a second wire to Port Darwin will be available by the end of August. This addition of a second string to the bow in the case of the trunk landline, which carries almost all the messages passing between England and Australasia, is very necessary, as we find that during the last five years both the West Australian and the South Australian trunk landlines have been simultaneously interrupted on no less than nine occasions, while there have been at least 50 interruptions in all on these landlines during the same period. These cases of interruption are only too familiar to the telegraphing public, but it would appear that there is one man in Australia who ignores them. The gentleman in question is the Hon. Mr. Playford who, as Agent-General for South Australia, gave evidence before the Pacific Cable Committee. In replying to the question whether the two landlines above referred to had ever been broken down at the same time, Mr. Playford says: "not that I am aware of." The "simultaneous breakdown" of these lines has often and widely been referred to on account of the great inconvenience caused to the public (and presumably also to the Australian Agents-General), but on this subject, as on others regarding which Mr. Playford has given evidence with much show of confidence, "we find that those correctly informed are not in agreement with the impression conveyed by the late South Australian representative."

Claim for Damage to a Submarine Cable—In the Queen's Bench Division last week, before Mr. Justice Bigham, the case of the Eastern Extension, Australasia and China Telegraph Company *v.* Weir was heard. It was an action brought against the defendants as owners of the ss. *Oatlands* to recover damages for injuries done to a submarine cable in the Straits of Bali in order to get the ship's anchor clear. Mr. Joseph Walton, Q.C., for the plaintiffs, stated that the parties had arrived at a settlement, the defendants having consented to judgment against them for £500 and costs. Counsel added that the plaintiffs had felt it their duty to press the claim as a warning to masters of ships that they must use proper care to avoid injuring telegraph cables, in the safety of which not only the company but the general public were largely interested. Judgment was given for the plaintiffs accordingly.

Misleading Information.—In October last we called attention to the grave errors to be found in a series of articles published in the Melbourne *Argus*, which strongly advocated the laying of a cable from Australia to the Cape by the Allied Eastern Companies, as opposed to the laying of a competing cable across the Pacific. The evidence given before the Pacific Cable Committee by the representatives of the Eastern Extension Telegraph Company, now places us in a position to expose still another misleading statement on an important point. The writer in the *Argus*, who otherwise shows himself to be well supplied with figures relating to the Eastern Extension Company, says: "There is hope that in a little while a further reduction of rates would be secured, the difficulty

being that out of the 4s. 9d. rate at present paid, the Eastern Extension Company only gets a shilling, the balance going to the Cis-Indian, European, Indian, Javan and Australian connections." This is in complete disagreement with the evidence given before the Pacific Cable Committee by the chairman of the Eastern Extension Company, as we find that instead of "only a shilling," the Eastern Extension Company get 2s. 4½d. as their share of the tariff. It would hardly be worth while drawing attention to this grossly misleading statement now, were it not that the article we refer to, which was published in Australia in the *Argus* of September 6th last, bears internal evidence of having been supplied, at least in part, from England; this is clearly shown by the use of "Cis-Indian," to indicate that portion of the cable route which lies between India and London.

The German Trans-Atlantic Cable.—The *Hamburger Correspondent* expresses regret at the rumour that the laying of the cable from Germany to the United States is being arranged for between the Imperial Post and Telegraph Office and an English company. It asks whether there is no German company capable of performing the work. A Reuter's telegram explains the situation in the following way:—

> In reference to the laying of the new cable from Germany to America, concerning which some surprise has been expressed that the concession should have been granted to an English company, it is declared in authoritative quarters that the cable, for technical reasons, has to be landed at the Azores, where the Telegraph Construction and Maintenance Company, of London, possesses the exclusive right of landing a cable. In order that the plan for the German cable might not be frustrated, the consent of the London company became necessary. The company agreed only on condition that it should be entrusted with the construction and laying of the cable, and it was thus that the concession came into the hands of an English company.
>
> It is added, however, that German interests have not been overlooked, inasmuch as the English company utilises to a considerable extent German material and German labour in laying the cable. It is further added that no German manufactory able to undertake the construction of laying such a cable exists at present, but that one is in course of formation, and should further submarine cables be decided upon, the order for them will be given to a German firm.

The above explanation is not quite correct, inasmuch as the capital of the Azores Telegraph Company is held by the Eastern Telegraph, and the Brazilian Submarine Telegraph Companies, as well as by the Telegraph Construction and Maintenance Company. Thus the concessions owned by the Azores Company are not utterly in the hands of the Telegraph Construction and Maintenance Company alone, as Reuter's explanation would seem to indicate. It seems that the laying of this German cable, which is designed to force what has been called "the English Telegraph Cable Blockade," may have considerable advantages for Germany, but will undoubtedly be the means of depriving the existing English trans-Atlantic cables of a large portion of their traffic. It remains yet to be seen whether the German Government will insist on a new cable direct from Emden to the Azores, which is not at all improbable, owing to the frequent interruptions which have occurred to the line connecting Emden with the Azores, *via* Vigo and Lisbon. In his evidence before the Pacific Cable Committee, Mr. Lamb, of the Post Office, expressed an objection to the decentralisation of telegraph communication. This new German cable may be looked upon as such a case, as undoubtedly, by the establishment of this line, which cuts England out, the Post Office department will sustain some loss of revenue.

The *Archiv für Post und Telegraphie* points out that the agreement which has existed since 1881 between the German Telegraph Administration and the Anglo-American Telegraph Company will expire during the current year. This agreement secured for the company the monopoly of the telegraph service between Germany and the United States. The number of sentences which the Anglo-American Telegraph Company carries in both directions during the year is from 2,700,000 to 2,800,000 (*sic*), while 700,000 to 800,000 messages pass between the United States and Germany on other cables, especially on those of the Commercial Cable Company. The new cable will be laid by the Deutsch Atlantische Telegraphengesellschaft, of Cologne. Starting from Emden it will go direct to the Azores, and from there straight to New York. The figures regarding traffic which are given above seem to be altogether excessive.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
Landlines.		
Communication between		
Salonika and Monastir ...	March 16th, 1899 ...	...
Port au Prince-Jeremie ...	June 14th, 1899 ...	...

The Trans-African Telegraph—Reuter's Agency is informed that Colonel Frank Rhodes, D.S.O., has been appointed managing director of the African Trans-Continental Telegraph Company. An iron telegraph pole made in two sections, and weighing together 90 lbs., has been constructed, and the question of its adoption is now being considered. The original poles weigh 180 lbs., but this weight was reduced to 112 lbs., and the newly-constructed pole is thus 22 lbs. lighter than that now in use. The line, which is now near Abercorn, will be pushed on with all speed to the next station, which is to be Ujiji, on the east bank of Tanganyika. As soon as the Uganda railway reaches a point sufficiently near Lake Victoria, the poles will be sent up from Mombasa by train and construction will be carried on simultaneously from Uganda and from Tanganyika.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—The Vestry has decided to issue advertisements for an overhead traveller and a battery of accumulators.

Canary Islands.—July 16th. Tenders are being invited until July 16th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system between Haria and Arrecife with three intermediate stations on the island of Lanzaroto, Canaries. Tenders to be sent to La Direccion General de Correos y Telegrafos, 10, Callede Carretas, Madrid, whence particulars may be obtained.

Dublin.—July 10th. The Richmond District Asylum Committee is inviting tenders for establishing telephonic communication between Portrane Asylum and Broadmeadow Waterworks. Mr. G. C. Ashlin, 7, Dawson Street, Dublin, is the architect.

Edinburgh.—July 18th. The Council wants tenders for installing the electric light at the Central Fire Station, Lauriston. See "Official Notices" this week.

Germany.—July 4th. The State Small Arms Works authorities at Spandau are inviting tenders until July 4th for the supply of 1,200 incandescent lamps, and 13,000 sets of arc lamp carbons. Particulars may be obtained from, and tenders are to be sent to, Der Direktion der Gewehrfabrik, Spandau, near Berlin.

Glasgow.—July 22nd. The Corporation wants tenders for boilers, steam engines (main and auxiliary), three-phase generators, continuous current generators, rotary converters, boosters, and static transformers, surface condensers, feed pumps, circulating pumps, and air pumps, all for the electric traction scheme. See our "Official Notices" June 23rd.

Glasgow.—July 22nd. The Corporation wants tenders for 80 electric tramcar bodies to sample and drawing. See "Official Notices" June 23rd.

Halifax.—July 15th. The Corporation wants tenders for a combined steam engine and dynamo. See "Official Notices" this week.

Hammersmith.—July 5th. The Vestry wants tenders for the supply of (*a*) transformers, (*b*) high and low tension substation switch gear; (*c*) transformer street boxes. Specifications, &c., obtainable at the Clerk's office, Town Hall, on deposit of £2 2s. Specifications can be seen at the office of the Electricity Department, 57, Fulham Palace Road. See our "Official Notices" June 23rd.

Morecambe.—The Council wants tenders for an economiser for the electricity works. See "Official Notices" June 23rd.

Nelson.—July 5th. Tenders are wanted by the Gas and Electricity Committee for the supply of an engine and dynamo (25 to 50 kw.), new or second-hand. See "Official Notices" June 23rd.

Pembroke.—July 14th. The Electric Lighting Committee wants tenders for a jet condenser with air pump and cooling apparatus. See "Official Notices" June 16th.

Rathmines and Rathgar.—July 14th. The Electric Lighting Committee wants tenders for arc lighting equipment (108 series parallel lamps, posts and switch-gear, &c.), steam and other pipes, jet condenser and cooling apparatus. See "Official Notices" June 16th.

Salford.—July 18th. The Tramways Committee wants tenders for the supply of a sample tramcar. See "Official Notices" this week.

Southampton.—The Council is wanting tenders for continuous current motor boosters, tramway switchboard, battery of accumulators, and accessories. See our "Official Notices" June 23rd.

South Shields.—July 10th. The corporation wants tenders for the supply and erection of arc lamps and posts. See "Official Notices" this week.

Wallasey.—July 20th. Tenders are wanted by the Council for alternating current transformers. See "Official Notices" June 23rd.

Wallasey.—July 20th. The Council wants tenders for a 300 kw. alternator with engine combined. See "Official Notices" June 23rd.

Warrington.—July 18th. The Corporation invites tenders for Babcock & Wilcox boilers, economisers, and pumps; high speed engines, direct coupled continuous current dynamos, balancers, and boosters; jet condensing plant, &c.; pipe work; 10-ton crane; switchboard, storage battery, mains, conduits, boxes; arc lamps and posts. See "Official Notices" June 23rd.

West Africa.—July 10th. The Compagnie de Mozambique, of 45, Rue do Alecrim, Lisbon, is inviting tenders until July 10th for the concession for the establishment and working of a central electric power station at Beira for lighting and power purposes during a period of 25 years. Particulars from, and tenders to, above.

CLOSED.

Hampstead.—Tenders have been accepted by the Vestry for a feed water heater, steam and exhaust pipes, and an economiser for the extension of the electric lighting station, the total cost being £4,354.

London.—The Battersea Vestry on Wednesday accepted the following tenders in connection with the proposed electric light station :—

Feeders, distributing mains, and arc light leads :—Callender's Cable Company	£17,735
Water-tube boilers :—Babcock & Wilcox, Limited	5,340
Steam dynamos with Willans engines :—Mather & Platt ..	10,620

London.—The St. Pancras Vestry on Wednesday considered the following tenders received for the supply of two 750-H.P. engines and dynamos :—

Mather & Platt	£10,943
Willans & Robinson	11,117
Electric Construction Company	12,110
Siemens Bros. & Co.	12,348
Crompton & Co.	12,864
E. Scott & Mountain	13,167

The tender of Messrs. Siemens Bros. was accepted, the chief electrical engineer advising that after making allowances for steam consumption in accordance with the specification, the tender of that company worked out the most economical.

London.—Regarding the list of tenders published last week for the electric lighting plant, &c., at Mr. Chas. Wyndham's new theatre, Messrs. Marryat & Place, the lowest tenderers, write as follows :—

We are sorry to see our name at the bottom of your list of tenders, and we should like to explain through your columns that we only received the inquiry at the eleventh hour, owing to it having been misdirected. We made a hasty tender, but shortly after, discovering an oversight, we wrote the engineers asking their permission to withdraw, as we could not make the work pay, except at a considerably increased figure.

London.—Messrs. Foote & Milne have been entrusted by the Secretary of State for India with the whole of the electric lighting of the India office, the number of lights being equivalent to over 3,000 8-C.P. lamps.

Mersey.—The contract for steam dynamos and installation of electric lighting for the Wallasey and Woodside landing stages for the Mersey Docks and Harbour Board has been placed in the hands of Messrs. Ellis & Ward, Birmingham.

Roumania.—The municipal authorities of Bucharest, Roumania, lately invited tenders for the supply of a quantity of electric light mains. Seven firms—four German, one Austrian, one Italian, and one Roumanian—competed for the contract, the lowest offer being that of Messrs. Felten & Guillaume, of Mulheim.

FORTHCOMING EVENT.

Tuesday, July 4th.—At 8 p.m. Röntgen Society; annual meeting at 11, Chandos Street, Cavendish Square, to receive annual report and balance-sheet, to elect officers for the ensuing year, and to consider alteration of rules. Mr. C. W. Mansell-Moullin, M.D. Oxon., will deliver his presidential address.

NOTES.

The Charge Against a Consulting Engineer.—At the Cheshire Quarter Sessions at Knutsford on Wednesday, Henry Cleaver, described as a consulting engineer, of Southampton, was found guilty on the charge of unlawfully obtaining money by false pretences from Messrs. Stanley Davies & James Pollard, electrical engineers, of Hyde. The course adopted by the prisoner was to advertise for tenders for electric lighting plant, and when applied to, on payment of certain sums, he sent specifications, and requested further larger payments. The details of the case appeared in the ELECTRICAL REVIEW'S report of the previous hearing. Prisoner has now been sentenced to 12 months' hard labour, the chairman saying that he was guilty of what was a deliberate fraud from beginning to end. He was a person against whom manufacturers must be protected.

Appointments Vacant.—A junior demonstrator for the physical laboratory, and an instructor in electrical engineering, are wanted for the City and Guilds Technical College, Finsbury. See our "Official Notices" this week.

Physical Society.—At an ordinary meeting held June 23rd, Mr. T. H. Blakesley, vice-president, in the chair, a paper "On the Magnetic Hysteresis of Cobalt," by Prof. Fleming, Mr. A. W. Ashton, and Mr. H. J. Tomlinson, was read by Mr. Ashton. A rectangular sectioned circular ring of cobalt was insulated with silk tape and wound over with four secondary coils put on at quadrantal positions. Over these secondary coils six primary coils were placed, and the ring was submitted to a complete set of magnetic tests with a ballistic galvanometer. From these observations various curves have been plotted, and the results have been compared with a similar set of readings taken on a cast-iron ring. A chemical analysis of the cobalt showed that it contained about 1 per cent. of iron and 1 per cent. of nickel. The authors conclude that although in general form the magnetisation curve for cobalt resembles that of cast-iron, its hysteresis exponent is similar to that of annealed soft iron. The absolute hysteresis values corresponding to various maximum flux densities are, however, not very different from those of a typical variety of cast-iron. Prof. Everett referred to the fact that the sample of cobalt contained about 1 per cent. of iron, and said that it would be interesting to know how cobalt free from iron would behave. The chairman said that the hysteresis curves obtained from the step by step method could not be applied to dynamos, because the time taken to perform the cycle altered the shape of the curve. He would like to see the curves for cobalt determined in cases where the cycles were quickly executed. A "Discussion on Physical Tables" followed, and the Society adjourned until next October.

Gas Traction.—Mr. Percy Holyoake, secretary of the British Gas Traction Company, Limited, writes to the *Engineer*, taking exception to Mr. Parker's dismissal of gas traction on the ground that no practical data are available, in the following terms :—

Mr. Parker, in his paper read before the Engineering Conference at the Institute of the Civil Engineers, said that "no reliable practical data is available" respecting tramways being driven by gas engines working on the cars. Had Mr. Parker made inquiries, I would have been pleased to have provided him with this information, which I now take the opportunity of doing. Cars carrying respectively 40 and 52 passengers have now been running on the Blackpool, St. Anne's and Lytham Tramway Company's lines for upwards of three years. The total cost of running these, including repairs, taken over the whole period of working, is 3·47d. per car mile, the cost of gas being ·92d. per car mile. Passengers to the extent of 1½ millions have travelled on the cars.

Cars have also been running on a suburban railway at Trafford Park, near Manchester, for about 15 months, the cost of which is 3·1d. per car mile, including all running charges and repairs, and no complaints whatever have been made as to any nuisance arising from the use of gas.

It will be noted that Mr. Parker is told that if he applies for particulars he will get them. The present writer did so apply for particulars and they were promised a year ago, but they have failed to appear. Will Mr. Parker's application be equally unsuccessful?

Dangerous Units.—Our American contemporary, the *Electrical World and Engineer*, complains that the British Association has gone out of its way to burden mankind with a "practical" system of electro-magnetic units. It admits that the object of the British Association was to simplify and to rationalise the units; for the volt, the ampere, and the ohm are directly within the range of quantities convenient to electricians. The simplification, however, introduced a *dual* system, a quadrant-eleventhet-gramme-second system, as distinct from the centimetre-gramme-second system, and this duality is the chief cause of the present complaint. As an antidote, the article prescribes a unit of current called the "*flu*," which, with the prefix "deci," is to denote the present ampere, or "deciflu." On this side of the Atlantic we are unfortunately too familiar with the decimations of the "*flu*" to desire any closer acquaintance with it; such a unit, in the hands of the amateur, would be almost as dangerous as a kilowatt. Moreover, the innovation is further to be deprecated on the plea of expediency; for if the custom of crowning eminent electricians with the unitary laurel is to be discontinued, what other means in these days are there left for conferring immortality, quickly and cheaply, upon the mere scientist?

Electricity Accounts.—Before the conference of the members of the Corporate Treasurers' and Accountants' Institute at Plymouth last week, Mr. H. M. Stevens, the borough accountant of Brighton, read a paper on "Corporation Electricity Accounts." In the discussion which followed, the town clerk of Plymouth, Mr. J. H. Ellis, said that—

> The strength of the paper lay in what was said on the question of sinking funds and depreciation funds. Many instances could be shown which pointed to the fact that the Local Government Board, in fixing the terms for repayments of loans by local authorities, acts upon no principle at all. It acted on an idea which was based on a misconception, and a misapprehension of the fundamental difference between local and national indebtedness. It proceeded on the idea that the growth of local indebtedness was a thing to be deplored, and ignored the growth of local assets which resulted from the increase of local indebtedness. The writer of the paper had quoted a case in which the Local Government Board had fixed a period of 12 years for the repayment of a loan of no less than £56,000. In that case the borough of Brighton was expected to make upon its undertaking an interest of close upon 12 per cent. before it could get a shilling towards the relief of the rates. What electric undertaking could dream of paying such a percentage? Parliament itself limited the dividends which companies could earn, and properly so, but a local authority if it was to escape a charge on the rates, must make more dividend on capital than experience showed a company was able to earn. It was their lack of principle in cutting down the terms of repayment because the Local Government Board wished to curb the growth of that local indebtedness which in sanitary matters it did so much to encourage, that he objected to. Local authorities ought to be allowed terms for repayment more commensurate with the life of the undertaking. Again, the undertaking should be treated as a whole, with one adequate term for it.

The Cycle Engineers' Institute.—Messrs. R. E. & C. Crompton are shortly to read a paper, illustrated by cinematograph, before this Institute at Birmingham. The paper will deal chiefly with the selection of gearing and crank throw for cycles. The address of the first president, delivered at a recent meeting, referred, among other things, to the advantages of electrical power transmission in cycle factories.

Personal.—Mr. C. H. Gadsby, Wh. Sc., M.I.E.E., has resigned his post as contract engineer to the British Electric Traction Company, for the purpose of devoting himself to private practice as a consulting electrical engineer, and has opened offices at 20, Victoria Street, Westminster, S.W., where he will make electric traction work his speciality. The British Electric Traction Company has retained Mr. Gadsby as engineer for the Devonport tramways.

Mr. Magnus Maclean, M.A., B.Sc., F.R.S.E., of Glasgow University, has been appointed to the chair of electrical engineering recently vacated by Prof. A. Jamieson at the Glasgow and West of Scotland Technical College. There were 10 applications. After a distinguished career at the University of Glasgow, Dr. Maclean was appointed in 1884 official assistant to Lord Kelvin, and in 1895 was elected University lecturer in pure and applied electricity. We understand that his candidature was strongly supported by many of the leading Glasgow electrical engineers in all branches of the profession.

Motor Car Exhibition.—On Monday, July 3rd, a motor car exhibition, promoted by Messrs. Cordingley & Co., will be opened at the Agricultural Hall, Islington. The promoters have decided, in addition to awarding certificates for gold medals, to give prizes of £25 each for electric carriages weighing under 1 ton, to carry two passengers; electric carriages weighing under 1½ tons to carry four passengers; passengers to average a minimum of 10 stone in weight. For the longest distance over ordinary roads at a maximum speed of 12 and a minimum speed of 10 miles per hour; same carriage with the batteries to be eligible for speed tests for any road with a gradient of not less than 10 per cent. on it.

Appointment.—The Leeds Tramways Committee has appointed Mr. W. R. Spaven traffic manager of the tramways (7 miles electric, 7 miles steam, and 10 miles horse).

Engineers' Wages.—An adjourned conference was held on Wednesday at Westminster Palace Hotel of representatives of the Engineering Employers' Federation and the Amalgamated Society of Engineers, to discuss the wages question in Mid Lancashire, and other matters. The meeting was held with closed doors.

Marriage.—Mr. F. G. Baily, M.A., professor of electrical engineering at the Heriot-Watt College, Edinburgh, was on 22nd inst. married to Margaret N. Osborne, daughter of the late G. H. Pagan, Sheriff-Clerk of Fife.

The Pacific Cable.—Yesterday Sir M. Hicks-Beach and Mr. Chamberlain received a deputation from the Eastern and Eastern Extension Telegraph Companies at the Treasury, respecting the all-British Pacific cable project. The Marquess of Tweeddale introduced the deputation. The cable companies urged that State interference with private enterprise was neither justifiable nor necessary in this case, for rates could be reduced and an alternative cable route to Australia arranged without it, on reasonable terms. The Cape route would be the best alternative route from all points of view. The Government policy would create an absolute and objectionable monopoly, inasmuch as the existing companies would be at their mercy. Mr. F. A. Bevan followed in a similar strain, and Sir M. Hicks-Beach and Mr. Chamberlain replied. The former said that the companies had in a way put themselves out of court by speaking as if it were quite a new thing for the Government to undertake work which has been or is being done by private enterprise. The companies had themselves received very substantial subsidies from the Australasian Governments, and now they told the Government they had no right to establish a cable between England and Australia, because the companies had a monoply! That was saying too much. Mr. Chamberlain said that in the case of the Cape there hardly arises any critical situation but one or other of the cables always breaks down. He also referred to the high rates charged. They seemed to think the Government had no regard for profit and loss in connection with the scheme. As to competition he thought that the companies' fears were unfounded, and that when the Pacific cable was worked it would be found to merely furnish an alternative route.

The Manchester Steam Users' Association.—The annual memorandum of the chief engineer has been sent to us. It is a very excellent production, and contains some useful information on furnace strengths, with tables of tests upon experimental furnaces. It deals also with the strength of riveted joints, and with the weights, costs, and dimensions of various types of boiler. There are also some records of tests, and there is a little expressed satisfaction in regard to the fining and possible imprisonment of a man who had been found responsible for an explosion. A note of warning is struck against attempting to secure too high percentages of strength in riveted joints, which are stated as never being really stronger than 68 per cent. of the solid plate, but this section would have been more valuable to engineers if accompanied by fuller statements as to the type of joint referred to, if double or treble riveted, &c. It is stated that a joint of nominally 75 per cent. strength is worth 68·4 per cent., while one designed for 87½ per cent. is not really worth over 64·6 per cent. Experiments are said to have been made on riveted specimens, but only the results are given. It would have been interesting to have had the details, so that comparisons could have been made with other experiments. If the nominally 75 per cent. joint is actually the best possible joint at 68·4 per cent. actual strength, it would be interesting to have a drawing in detail of the dimensions of this joint, its rivet diameters, &c. The section on riveted joints as it stands is practically a condemnation of most riveted joints as now employed for high pressure boilers. We are glad to see the Manchester Steam Users' Association taking up some of these vexed questions and carrying out experiments.

NEW COMPANIES REGISTERED.

St. Helens Cable Company, Limited. — Registered on June 8th, by T. T. Hull, 22, Chancery Lane, W.C., with a capital of £50,000 in 4,200 £10 shares and 4,000 £2 shares. Objects: To acquire and take over as going concerns both or either of the businesses of "William James Glover & Co." and "Hanchett and Co., Limited;" to enter into agreements (1) with Benjamin B. Glover and Wm. J. Glover; (2) with Geo. E. Heyl-Dia and Hanchett and Co., Limited, of the first part, William Hanchett of the second part, and Geo. E. Heyl-Dia of the third part; (3) with Geo. E. Heyl-Dia; (4) with Wm. J. Glover; (5) with Robert B. Glover; and (6) with William Hanchett; and to carry on the business of cable and wire rope manufacturers, &c. The subscribers (with one share each) are:—J. Crook, Eccleston Park, Prescot, Lancashire; J. Hamill, Windle House, St. Helens, Lancashire; H. Rawlinson, Cropper's Hill, St. Helens; W. Oppenheim, Highfield, St. Helens; J. T. Wright, 39, Grey Road, Walton, Liverpool; H. S. Oppenheim, Highfield, St. Helens; J. C. Wood, 49, Denton's Green Lane, St. Helens. The number of directors is to be five; the first are Wm. J Glover, Geo. E. Heyl-Dia, and three others to be appointed by the debenture holders; qualification, £500; remuneration as fixed by the company.

Italian Mutoscope and Biograph Company, Limited (62,452).—This company was registered on June 13th, with a capital of £40,000 in £1 shares, to manufacture and deal in mutoscopes, biographs, and mutographs in the kingdom of Italy, and to carry on the business of mechanical and electrical engineers, &c. The first subscribers (each with one share) are:—T. MacDonnell, 2, New Court, Lincoln's Inn, barrister; A. J. George, 33—37, Hatton Wall, E.C., manufacturer; W. T. Smedley, 119, Ashley Gardens, Westminster, chartered accountant; E. B. Koopman, Hotel Cecil, W.C., managing director; J. H. Brigham, Hotel Cecil, W.C., managing director; W. Bartram, 18, Great Windmill Street, London, clerk; and E. Shouls, 42, Balfern Grove, Chiswick, clerk. The first directors, to number not less than two nor more than seven, are to be nominated by the subscribers; remuneration, £120 each per annum.

Wilsons & Mathiesons, Limited (62,486).—This company was registered on June 8th, with a capital of £115,000 in 6,000 preference shares of £5 each, and 85,000 ordinary shares of £1 each, to acquire from Charles Wilson & Sons and Mathieson, Wilson and Co., certain factories and premises in the city of Leeds, to adopt an agreement with the said vendors, and to carry on the business of engineers, machinists, iron and steel founders, tool makers, electrical engineers, gas stove manufacturers, ironmongers, &c. The first subscribers (each with one share) are:—Charles C. Wilson, Blenheim Terrace, Leeds, gas stove manufacturer; William Mathieson, Riseholm, Horsforth, ironfounder; Henry Wilson, Rock View, Armley, Leeds, gas stove manufacturer; Thomas A. Draper, Oak Villa, Venery Road, Leeds, ironfounder; James W. Wilson, Summer Hill, Leeds, gas stove manufacturer; Alexander Mathieson, Spring Grove Terrace, Leeds, ironfounder; Charles A. Wilson, Blenheim Terrace, gas stove manufacturer. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £1,500; remuneration, £500 per annum divisible. Registered office, Carlton Works, Canal Road, Armley, Leeds.

B. Rhodes & Company, Limited (62,506).—This company was registered on June 10th, with a capital of £10,000 in £1 shares, to carry on the business of miners, ironmasters, machinists, mechanical and electrical engineers, &c. The first subscribers (each with one share) are:—John H. Stott, Cranbourne Road, Bradford, dyer; Frank H. Bentham, 16, Laisteridge Lane, Bradford, wool comb maker; William H. Greenwood, Summerfield, Idle, near Bradford, commission wool comber; John J. Whittaker, Holme House, Esholt, Shipley, provision merchant; Thomas Priestley, Bank Top House, near Bradford, manufacturer; William H. North, Clellow Dean, Allerton, dyer; and Fred. Foster, Normandy Villa, Shipley, wool and waste merchant. The first directors (to number not less than three nor more than seven) are to be appointed by the subscribers; qualification, £250; remuneration as fixed by the company.

W. R. Sykes's Interlocking Signal Company, Limited (62,522).—This company was registered on June 12th, with a capital of £100,000 in £1 shares, to enter into an agreement with William R. Sykes, to acquire the business known as "Sykes's System of Interlocking Railway Signals and Points," now carried on at Station Road, High Street, Clapham, and to carry on the business of signal manufacturers, electrical and mechanical engineers, telephone and telegraph manufacturers, &c. The first subscribers (each with one share) are:—George Beeson, 2, Clarendon Terrace, W., clerk; Archie W. Kemp, 12, Tarver Road, Manor Place, S.E., clerk; T. Morton, 53, Nunhead Grove, S.E., surveyor, Sidney E. Newman, 72, Romilly Road, N., clerk; P. J. Taylor, 11, Old Broad Street, E.C., solicitor; Francis R. Roberts, 11, Old Broad Street, E.C., solicitor; and Edward Sorrell, 50, Idmiston Road, Stratford, E., clerk. The number of directors is not to be less than two nor more than seven; the first are to be nominated by the subscribers; qualification, 250 shares; remuneration, £200 each per annum, and £250 for the chairman. Registered office, 65, New Broad Street, E.C.

Galloways, Limited (62,540).—This company was registered on June 13th, with a capital of £300,000 in £10 shares, to adopt an agreement with "Galloway's, Limited," and its liquidator, and to carry on the business of ironfounders, boiler makers, mechanical, electric, hydraulic, gas and general engineers, tube makers, brass founders, coppersmiths, millwrights, colliery proprietors, suppliers of electricity for the purposes of light, heat, or power, electric and other motor car builders, cycle manufacturers, &c. The first subscribers (each with one share) are:—Charles J. Galloway, Thornleyholme, Knutsford, Cheshire, gentleman; William J. Galloway, 47A, Portland Place, W., M.P.; Edward N. Galloway, Normanby, Altrincham, engineer; Arthur W. Galloway, Thornleyholme, Knutsford, Cheshire, engineer; Richard Mottram, Kt., Beech House, Pendleton, Salford; W. H. Norbury, West View, Chorlton-cum-Hardy, Manchester, engineer; and Charles Rought, 17, Philpot Lane, E.C., engineer. The number of directors is not to be less than four nor more than ten; the first are Charles J. Galloway, Edward N. Galloway, Arthur W. Galloway, William J. Galloway, Richard Mottram, William E. Norbury, and Charles Rought; qualification, £500; remuneration, £700 per annum, divisible.

Road and Tramcar Electric Traction Company, Limited (62,562).—This company was registered on June 14th, with a capital of £12,000 in £1 shares, to acquire any patents and rights, to manufacture and deal in any machinery, articles and implements, and to carry on the business of electric and other tramway proprietors. The first subscribers (each with one share) are:—Edward Choat, Grosvenor Villa, Loughborough Road, Brixton, clerk; Walter Chivers, 79, Hugh Street, Eccleston Square, S.W., clerk; Edward Trearn, 86, Mexfield Road, Putney, manager; Francis Head, Thames Bank, Hampton Wick, architect; William R. Smith, 117, Victoria Street, S.W., civil engineer; Edward B. Robbins, 7, Smeaton Road, Wandsworth, S.W., clerk; and Harold P. Stringer, 7, Sarsfeld Road, Balham, S.W., clerk. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first qualification, £100; remuneration, £50 each per annum, and £60 for the chairman.

City of Carlisle Electric Tramways Company, Limited (62,601).—This company was registered on June 16th, with a capital of £60,000 in £1 shares, to acquire the powers and rights conferred by the Carlisle Tramways Order, 1898, to enter into an agreement between Wm. B. Needham, E. Horton, J. J. Gittings and W. J. Kershaw of the first part, the Manchester Traction Company, Limited, of the second part, and this company of the third part, and to carry on the business of carriers, electricians, electrical and general engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—John Law, 3, 8, Manchester Road, Rochdale, estate agent; Frederick Cox, 17, Cresswell Grove, West Didsbury, accountant; Frederick Crunes, 5, Meriner Street, Greenheys, Manchester, secretary; Arthur O. Kay, Mayfield, Rochdale, gentleman; Frederick W. Browne, 66, Duke Street, Old Trafford, Manchester, clerk; Frank H. Poole, Wynnstay House, Fallowfield, Manchester, solicitor; and John C. Barrows, 89, Clarendon Road, Whalley Range, Manchester, clerk. The first directors (to number not less than four nor more than seven) are George Richardson, George Readman, Robert B. Barningham, and Thomas D. Lingard; qualification, £250; remuneration as the company may decide. Registered office, 13, Spring Gardens, Manchester.

Western Telegraph Company, Limited (62,586).—This company was registered on June 15th, with a capital of £1,000 in £1 shares, to acquire or construct telegraph and telephone wires and cables, to acquire, own and work any patents and rights relating thereto, and to construct and maintain telegraph, telephone, electric lighting and other works. The first subscribers (each with one share) are:—F. Dawes, 50, Old Broad Street, E.C., solicitor; W. Chapman, 50, Old Broad Street, E.C., solicitor; E. H. T. Bradley, 19, Linden Gardens, W., gentleman; A. Robinson, 101, East Hill, Wandsworth, gentleman; A. E. Newman, 33, Glebe Road, Hornsey, gentleman; H. J. Emery, 22, Leyland Road, New Cross, S.E., law student; and A. J. Kent, 8, Cross Road, Wimbledon, accountant. Registered without articles of association.

Electrical Corporation, Limited (62,630).—This company was registered on June 19th, with a capital of £30,000 in £1 shares, to adopt an agreement with J. E. Harding, and to carry on at Valparaiso, or elsewhere, the business of electricians, mechanical engineers, tramway proprietors, suppliers of electricity for the purposes of light, heat, and motive power, electrical apparatus manufacturers, cable and wire manufacturers, &c. The first subscribers (each with one share) are:—J. A. Bower, 17, Gracechurch Street, E.C., engineer; F. L. Vaughan, 84, Winchester House, E.C., gentleman; S. Kempson, 437, Kingsland Road, N., gentleman; A. G. Webb, 39, New Broad Street, E.C., solicitor; L. Schramm, Gracechurch Street, E.C., electrical engineer; E. Ellis, Lime Street, E.C., merchant; and J. Phillips, Great Dover Street, W., accountant. The number of directors is not to be less than two nor more than five; the first are J. A. Bower and F. L. Vaughan; qualification, £100; remuneration as fixed by the company.

Sea Serpent Syndicate, Limited (62,632).—This company was registered on June 19th, with a capital of £5,000 in £1 shares, to adopt an agreement with Walter Stenning, and to carry on the business of builders, electricians, mechanical and electrical engineers, hardwaremen, ironmongers, &c. The subscribers (each with one share) are:—C. E. Braun, 36, Gray's Inn Road, W.C., hardware importer; J. S. Flanagan, Moorgate Station Chambers, E.C.; C. J. Shaw, 49, Finsbury Pavement, E.C., architect; J. Galetti, 49, Finsbury Pavement, E.C., architect; H. F. Ranger, 1, Quality Court, E.C., solicitor; C. W. Brownjohn, 1, Quality Court, E.C., clerk; C. J. Kington, 1, Quality Court, E.C., clerk. The number of directors is not to be less than three nor more than five; the first are C. E. Braun, W. H. Pullin, J. S. Flanagan, and W. Stenning (managing director); remuneration of W. Stenning, 10 per cent. of the net profits; others, 5 per cent. of the net profits, divisible. Registered office, Moorgate Station Chambers, E.C.

Helios Electrical Construction Company, Limited (62,633).—This company was registered on June 19th, with a capital of £10,000 in £10 shares, to carry on the business of electrical engineers, electricians, and manufacturers of electrical apparatus of all kinds. The first subscribers (each with one share) are:—S. C. Witting, Hollingbury Copse, Patcham, Sussex, merchant; F. Charles, 49, Cannon Street, E.C., merchant; C. Schaller, 7, Göberstrasse, Cologne; P. La Ruelle, Göberstrasse, 3, Cologne, electric works manager; J. Stubben, Sachsensing, Cologne, electric works manager; L. Wiese, 49, Cannon Street, E.C., merchant; and H. R. Witting, 19, Mill Hill Road, Acton, W., merchant. The number of directors is not to be less than two nor more than seven; the first are S. C. Witting, F. Charles, L. Weise, C. Schaller, and P. La Ruelle; qualification, £1,000.

Norwich Mutual Telephone Company, Limited (62,640).—This company was registered on June 19th, with a capital of £20,000 in £1 shares, to establish and maintain a telephonic exchange or exchanges, and to acquire and carry on the business of the Norwich Telephone Company. The first subscribers (each with five shares) are:—C. Bussey, Palace Plain, Norwich, merchant; F. G. Hatch, 15, Haymarket, Norwich, solicitor; H. H. C. Jarrold, Bracondale, Norwich, publisher; S. D. Page, Exchange Street, Norwich, cabinet maker; W. P. Shave, 7, Colegate Street, Norwich, merchant; C. Steward, King Street House, Upper King Street, Norwich, solicitor; and W. H. Webster, Gablehurst, Eaton, Norwich, draper. The number of directors is not to be less than three; the subscribers are to appoint the first; qualification, £50. Registered office, King Street House, Upper King Street, Norwich.

Anglian Cycle and Engineering Company, Limited (62,689).—This company was registered on June 23rd, with a capital of £15,000, in 1,470 ordinary shares of £10 each and 300 founders' shares of £1 each, to acquire and carry on the business of an electrical engineer carried on by N. Prentice, at Stowmarket and elsewhere, and the business of cycle manufacturers and engineers, carried on as Stannard & Alger, by R. Stannard & C. B. Alger. The first subscribers (each with one share) are:—R. Stannard, Stowmarket, engineer; C. B. Alger, Diss, engineer; H. N. Prentice, Stowmarket, engineer; F. C. Peacock, Stowmarket, solicitor; C. B. Alger, Diss, photographer; P. C. N. Peddar, Stowmarket, land agent; and S. A. Maw, Needham Market, bank manager. The number of directors is not to be less than three nor more than seven. The first are H. N. Prentice, R. Stannard, C. B. Alger, P. C. N. Peddar and S. A. Maw; qualification, £100.

Totnes Electricity Supply Company, Limited (62,693).—This company was registered on June 23rd, with a capital of £10,000 in £1 shares, to apply to the Board of Trade for a provisional electric lighting order and for such licenses and authorities as may be required for securing to the company the right to supply electricity for lighting and other purposes to Totnes and the surrounding districts, to carry on the business of electricians, electrical engineers, &c., and to adopt an agreement with G. E. S. Venner. The first subscribers (each with one share) are:—J. Sparrow, 16, Grove Mansions, Clapham Common, gentleman; R. F. W. Orr, Pemberley Cottage, Bedford, gentleman; J. F. Figg, 10, Southwark Bridge, S.E., stationer; H. J. Wood, Prima Road, Brixton, clerk; A. J. Barclay, 94, Brook Green, W., gentleman; J. Moyes, 48, Tynemouth Road, South Tottenham, N., clerk; G. W. Cole, 73, Lloyd Road, Walthamstow, accountant. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 200 shares; remuneration, £200 per annum, divisible. Registered office, Granville House, 3, Arundel Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

West Coast of America Telegraph Company, Limited (52,114).—This company's annual return was filed on May 27th, when 45,000 shares were taken up out of a capital of £132,520 in 52,008 shares of £2 10s. each, all the shares being considered as fully paid.

New General Traction Company, Limited (47,321).—This company's annual return was filed on May 22nd, when 30,000 preference and 24,000 ordinary shares were taken up out of a capital of £370,000 in 50,000 preference and 24,000 ordinary shares of £5 each. The ordinary shares are considered as fully paid, and £5 has been called on the preference, resulting in the receipt of £150,000. The capital was increased from £270,000 to £370,000 by special resolution dated May 8th, 1899.

Western and Brazilian Telegraph Company, Limited (7,251 C).—This company's annual return was filed on May 31st, when 64,269 £15 shares and 66,258 £7 10s. shares were taken up out of a capital of £1,500,000 in 66,871 shares of £15 each, and 66,258 shares of £7 10s. each. The full amount has been called, resulting in the receipt of £1,461,535, which includes £565 paid on 75 forfeited shares.

Altrincham Electric Supply Company, Limited (40,795).—This company's annual return was filed on May 24th, when 25,000 shares were taken up out of a capital of £50,000 in £1 shares. The full amount has been called, and £25,000 received.

Woolwich District Electric Light Company, Limited (31,814).—This company's annual return was filed on June 16th, when 12,000 shares were taken up out of a capital of £25 000 in £1 shares. 2,884 are considered as fully paid. £1 has been called on the remainder, resulting in the receipt of £9,116.

Syndicate of Electrical Engineers, Limited (30,531).—This company's annual return was filed on May 10th, when 1,002 ordinary and 100 founders' shares were taken up out of a capital of £10,000 in 1,900 ordinary and 100 founders' shares of £5 each. The founders' shares are considered as fully paid. £4 has been called on the ordinary, and £4,008 received.

African Direct Telegraph Company, Limited (21,895).—This company's annual return was filed on May 31st, when 23,600 shares were taken up out of a capital of £300,000 in £10 shares. The full amount has been called and £236,000 received.

CITY NOTES.

Callender's Cable and Construction Company, Limited.

The directors' report for the year ending December 31st, 1898, reads as follows:—

The directors submit herewith the accounts for the year ending December 31st, 1898, showing a balance at the credit of Profit and Loss of £46,840 6 7

From which must be deducted interest on debentures ...	£4,050	0	0	
Dividend on preference shares ...	1,577	17	1	
Appropriation for depreciation of machinery, plant, &c.	5,000	0	0	
				10,627 17 1
Leaving an available balance of ...				£36,212 9 6

Which it is proposed to deal with in the following manner:—

1. By the payment of a dividend to the holders of ordinary shares at the rate of 10 per cent. per annum (clear of income-tax), being 10s. per share, whereof 5s. was paid on November 1st, 1898, as an interim dividend, leaving 5s. per share to be paid now	£10,000	0	0
2. By the payment of a bonus of 5s. per share ...	5,000	0	0
3. By placing to reserve	15,000	0	0
4. By carrying forward to next year's account ...	6,212	9	6
	£36,212	9	6

The total payments to the holders of ordinary shares for dividend and bonus for the year 1898 will therefore be at the rate of 15 per cent. per annum. The plant and premises have been maintained in a thorough state of efficiency, and the cost of renewals and repairs has been debited against the year's profits.

An entirely new additional factory has been erected on the land purchased in 1898, to which reference was made in last year's report, and a considerable sum has been expended on the plant and machinery therein. No advantage was, however, reaped in 1898 from that expenditure, as the first section of the new factory was only occupied early this year, and the most important part was only available for work a few weeks ago. The directors are satisfied that the advantages in decreased cost and increased speed of production fully justify the expenditure. The business transacted in 1898 was again much in excess of that in previous years, and continues to increase in a most satisfactory way, the contracts in hand at the present time exceeding half a million sterling in amount. It is evident to the directors that if full advantage is to be taken of the prosperity which the company now enjoys the means of production at Erith will have still further to be enlarged, and it may be necessary to take up other branches and new applications of cable work. The contracts which the company now undertakes necessitate the use of considerable floating capital, and, notwithstanding the recent issue of preference shares, the directors are of opinion that it is desirable to increase the capital still further. They recommend that power should be taken for the creation of 20,000 new preference shares, and 20,000 new ordinary shares, both of £5 each, to be issued from time to time as the directors may find necessary for the business of the company. The directors are very desirous that the annual accounts should be laid before the shareholders earlier in the year, but it has been found impossible to do this hitherto, owing to the continual and rapid increase in the company's business, which has thrown upon all the staff a large amount of extra work. With a view to relieve this pressure, and to expedite the preparation of the accounts, the directors propose to engage the services of Messrs. James Worley & Son as accountants to the company. The directors recommend this proposal to the shareholders, and have issued notice of an extraordinary general meeting to pass the resolutions necessary for giving effect to it (owing to their being already the auditors) as well as to increase the capital of the company. The directors think it is only right, whilst referring with so much satisfaction to the great prosperity of the company to acknowledge the unwearied zeal with

which all the staff have worked in order to secure such results, and without whose co-operation they could not have been attained. The retiring director is Lieut.-Col. G. A. Elliott, who, being eligible, offers himself for re-election. The auditors, Messrs. James Worley and Son, offer themselves for re-election.

Mr. H. Drake presided on Thursday last week over the third annual general meeting of the shareholders of the above company held at the offices, 90, Cannon Street, and in moving the adoption of the report, said he trusted that it would be as satisfactory to the shareholders as to the board. They would see that the business had largely increased during the year, and he was glad to say that it was still increasing. There were a few points he would draw their special attention to. In the first place the freehold property, leasehold, machinery and goodwill had increased from £107,000 to £135,000. They would observe in the report that an additional factory had been built at Erith, and the expenditure had been remunerative. In fact, they could not have carried on their work unless they had extended the plant and buildings. Then the next item, that of cable drums, had increased by £2,000. That was not a large amount, but it was a very good indication of the increase of the business. In the last balance-sheet that item stood at £2,800, and now it was £4,800. These drums were used to wind up the cables on, and it showed how much the business had increased, as the item had increased two-fifths. The stock in hand was £43,000 against £27,000, an increase of £16,000. The expenditure on contracts in course of execution was £42,000 against £18,000, which was an increase of £24,000. The next item was sundry debtors, £172,000, which, compared with £81,000 in the previous balance-sheet, showed an increase of £91,000. Then they had an increase of cash and bills receivable, amounting to £12,000. Shares in other companies were £1,000 less, but the item was worth considerably more than it stood at in the balance-sheet. On the other side of the account they had trade creditors and other liabilities, £119,000, as against £50,000, an increase of £69,000; but, inasmuch as their debtors had increased by £91,000, the difference was on the right side. Their balance to credit was £36,000 as against £17,000, and the balance at the credit of profit and loss was £46,840, from which they had to deduct £4,050 interest on debentures, £1,577 dividend on preference shares, and £5,000 appropriated for depreciation of machinery, plant, &c., leaving an available balance of £36,212. With their approval, they proposed to pay a dividend on the ordinary shares of 10 per cent., of which 5s. had been paid by way of interim dividend, to pay a bonus of 5s. per share, to place £15,000 to reserve, and to carry forward £6,212 to the next account. The dividend and bonus together was really 15 per cent. on the ordinary shares, which was very satisfactory. They would observe from the report that the contracts in hand at present exceeded half a million sterling. The business had not only increased during the year, but was still increasing, and there appeared to be no sign of diminution. Of course, they could not carry on that increased business without having larger means to do so, and at the extraordinary meeting which was to follow, they would be asked to increase the capital of the company. Last year an addition was made to the capital of the company to the extent of £100,000, by the issue of 20,000 preference shares of £5 each, nearly all of which were taken up by the shareholders, and the few left over were issued at a premium which more than covered the expenses of the issue. They now proposed to increase the capital by £200,000. They asked for power to do that, but they did not propose to issue the full amount at the present time. They asked for power to increase the ordinary share capital by £100,000, and the preference shares by a similar amount. That seemed a great deal, but if they referred to the figures in the balance-sheet, they would see where the £100,000 they had last year was gone. Those accounts came down only to December 31st, and they had since spent nearly an additional £20,000 in plant at Erith. There were some very important pieces of machinery still to be fixed at the factory, which would cost more money, and which would have to be paid for. Although they did not require the whole of the £200,000 at once, yet circumstances might arise, and they might have the opportunity of taking up large contracts, which would necessitate a further issue, and they found there would be no difficulty, should occasion arise, if they had the power to issue shares, in getting an advance from the bankers, which would tide them over an emergency. There was also another reason. In nearly all their contracts to the corporations with whom they did business 5 per cent. of the amount of the contract was retained for 12 months after the completion of the work in order to ensure the efficiency of it. That did not seem very much, but it was a large proportion of their profits, and if they took half a million pounds, which was not the whole of their work, it meant the locking up of £25,000. Another point referred to in the report was the suggestion to engage Messrs. Worley & Son to supervise the accounts of the company. Practically they wanted them to be auditing the accounts all through the year. The Chairman concluded by explaining the system of auditing the accounts now adopted, and pointed out the great benefit which would accrue to the company from having an improved system, but in order that Messrs. Worley could come in to supervise it necessitated the alteration of the articles of association.

Colonel Elliott seconded the adoption of the report, which was agreed to.

Mr. Callender, the managing director, said the prosperity of the company continued to increase, and the number of contracts they had in hand was absolutely unprecedented, and he was sure no other firm in the electrical or engineering business had a more expensive or a more healthy business than they had at present. They had work going on in 102 different towns, not only in that country but in Calcutta, the Cape of Good Hope, Australia, Hong Kong, South America, Spain, and Gibraltar. Besides these they had various contracts in that country. They had secured the best part of the contracts for the mains which had been placed in that country. They were doing the mains for a considerable part of London, and for Liverpool, Birmingham, Manchester, Edinburgh, Glasgow, and Dublin. With regard to the works, he considered they had the best works in the country.

An extraordinary general meeting was subsequently held, when resolutions were passed authorising the alteration of the articles of association and giving power to increase the capital of the company.

The Electric and General Investment Company, Limited.

The meeting of this company was held on Tuesday at Winchester House, E.C.

Mr. Geo Herring, who presided, regretted the presence of so few shareholders, but attributed this to the large dividends which were being paid. The report, he said, showed that they had made a net profit of £25,000 on a called-up capital of £20,000. It was the smallness of the paid-up capital that enabled them to pay the present dividends. No one could complain against the amount of money they had earned, and while he hoped it would continue, he warned everyone connected with them that it was a company which, being financial, naturally fluctuated to a certain extent in the dividends. Although they had had two very prosperous years, they must not look forward to that prosperity continuing, for the reason that the children that the company had brought into the world had all grown up, and although not one had deserted the company, they did not require the same financial assistance as had been rendered in the past. Looking over the various items in the accounts, the chairman said that, in view of their prosperity, they were justified in adding to the provision for contingencies the amount set down in the balance-sheet, and they hoped that it would cause a proportionate increase in the future dividends. The investments were as secure as anything could be. In regard to the founders' shares reserve fund, they had considered it a proper course that as they sold the securities for the founders' reserve fund that they should act towards the ordinary shareholders in the same manner, and that they had done. They had sold enough of the securities for the founders' to pay £20 a share, and enough of the ordinary reserve fund to pay the equivalent to the ordinary. That was the best course to adopt. He moved the adoption of the report and declaration of dividends as already noted in the Electrical Review.

The retiring directors (Messrs. J. B. Braithwaite, jun., and E. Garcke) were re-elected; also the auditor. Mr. Braithwaite was not present at the meeting, as he on his way home from America.

Mexico Electric Tramways Company, Limited.

The report of the directors of this company was presented on June 28th at a general meeting of the shareholders, Col. Sir Charles Euan-Smith, K.C.B., C.S.I., presiding. The report states that the conversion of the tramways to electric traction is being rapidly pushed forward, and a large part of the system will be in operation by the end of the year. The net profits of the tramways in 1898 amounted to £14,146, which was chiefly devoted to reserve fund. The gross receipts were £180,000, and about 22,000,000 passengers were carried.

In moving the adoption of the report, the Chairman stated that the receipts were steadily increasing, and the expenses diminishing, and in the directors' opinion the prospects of success were striking.

The report was adopted unanimously.

Thomas Parker, Limited.

The fifth annual general meeting of this company will be held at the works, Wednesfield Road, Wolverhampton, on Tuesday, July 4th, 1899, at 3.30 p.m.

The directors' report to be then presented says:—"Your directors have pleasure in submitting the annexed balance-sheet, which they consider thoroughly satisfactory. After writing off various depreciations the balance standing to the credit of profit and loss account is £17,689 6s. 6d.; out of this the directors propose to pay a dividend at the rate of 10 per cent. per annum, less income-tax, amounting to £7,250, to place £8,000 to the reserve fund, and to carry the balance forward to next year's account. As will be seen from the balance-sheet, debentures to the amount of £20,500 have been issued to shareholders and their friends. Your directors will be pleased to receive further applications which would enable them to carry out extensions in the works and business, and at the same time reduce the balance due to the bankers. The director who retires by rotation is Mr. R. Armistead, who is eligible for and offers himself for re-election. The auditors, Messrs. Allen Edwards & Smith also retire, but are eligible for and offer themselves for re-election."

F. H. Royce & Co., Limited.

A meeting of the shareholders was held on Monday at Manchester. Mr. E. A. Claremont presided. The report of the directors, which was read showed that the year's profit up to March 31st last was £6,684, to which was added a balance from last year of £46, making £6,730 available for dividend, out of which an interim dividend at the rate of 6 per cent. per annum was paid on September 30th, 1898. It was now resolved that dividends be paid at the rate of 6 per cent. per annum on the preference shares, 6 per cent. on the ordinary shares, and £9 per share on the deferred shares.

United River Plate Telephone Company, Limited.

The report for the year ended March 31st states that the gross receipts in sterling for the year in the River Plate were £85,248, as against £67,208 for the year before, and the working expenses in the River Plate £41,920. After the deduction of debenture interest and London charges—but less transfer fees, interest on investments, and profit on sale of securities—there is a profit of £33,333, to which must be added £6,955 brought forward. The directors propose to transfer £5,000 to depreciation fund and £10,000 to reserve fund. They recommend that a dividend of 6 per cent., free of tax, be paid on the ordinary share capital, and that the balance of £7,889 be carried forward. The increasing business of the company makes it necessary to provide for additional working capital, and a resolution will be proposed at the general meeting providing for the issuing of 40,000 of the remaining 42,000 unissued shares of £5 each as 5 per cent. cumulative preference shares. It is intended to make an early issue of 20,000 of these shares.

Prospectus.

The name of Belliss stands in the front rank of English engine makers. The popularity of the Belliss engine for electric lighting, power, and traction generating plants is clearly evidenced by the fact that upwards of 1,000 plants, aggregating about 100,000 H.P., have been supplied by the firm or are now in course of construction. In the prospectus of Belliss & Morcom, Limited, which has been before the public this week for subscription, there is given a list of the numerous municipal authorities, electricity supply companies, tramway companies, governments, works, &c., for which these orders have been received or executed. The new company (Belliss & Morcom, Limited) takes over the old-established business which has been carried on at the Ledsam Street works, Birmingham, under the title of G. E. Belliss & Co., Limited. Latterly nearly the whole of the capital has been in the hands of Mr. Belliss and Mr. Alfred Morcom, hence the change of name in the new company. Belliss & Morcom, Limited, has a capital of £300,000 divided into 15,000 £10 ordinary shares and 15,000 5 per cent. £10 preference shares. The issue for which the lists were open until Tuesday last is for £100,000 ordinary capital (allotted to shareholders in the vendor company) £100,000 preference capital, and £100,000 4 per cent. debentures, the vendors also taking £26,500 preference and £40,000 debentures. The balance of £73,500 preference and £60,000 debentures have, we do not doubt, been very readily subscribed for by those who know the reputation enjoyed by the company and its engines in electrical and other circles. The assets acquired from the vendor company are valued at £196,427, and liabilities to trade creditors (£16,287) are taken over. The book debts are guaranteed to produce £29,170. The vendor company takes £245,000 (£78,500 cash and the rest in shares). The present issue will, after paying purchase money, leave £55,000 for further working capital and extensions. Preference and debenture interest takes £9,000 per annum, and for the last 2¾ years the average surplus profit has been £13,854.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to allow the following to be quoted in the Official List:—Telegraph Manufacturing Company, Limited—6,600 vendors' 5 per cent. cumulative preference shares of £5 each, fully paid, Nos. 1 to 6,600, and 6,600 vendors' £5 ordinary shares, fully paid, Nos. 1 to 6,600. Application has also been made to the Committee to appoint Wednesday, July 5th, a special settling day in Davis & Timmins, Limited—27,000 ordinary shares of £1 each, fully paid, Nos. 1 to 27,000, and 60,000 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 50,000 to 110,000, and to allow same to be quoted in the Official List; and to appoint a special settling day, and grant a quotation for Mather and Platt, Limited—32,500 5 per cent. cumulative preference shares of £10 each; Nernst Electric Light, Limited—115,000 7 per cent. preference shares of £1 each.

Electric Construction Company.—The transfer books for the 4 per cent. perpetual first mortgage debenture stock will be closed from 1st to 14th prox. inclusive, and for the ordinary and preference shares from 29th inst. to 13th prox. inclusive.

Cape Electric Tramways, Limited.—The directors announce an interim dividend of 3½ per cent., free of income-tax, payable on receipt of the transfer returns from South Africa. The transfer books will be closed from 6th to 11th prox. inclusive.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending June 24th, 1899, were £611 12s. 9d.; aggregate to date, £9,821 8s. 1d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 24th, 1899, were £3,023 9s. 9d.; corresponding period 1898, £2,828 19s. 8d.; increase, £194 10s. 1d.

The City and South London Railway Company.—The receipts for the week ending June 25th, 1899, were £933; week ending June 26th, 1898, £966; decrease, £33; total receipts for half-year, 1899, £26,950; corresponding period, 1898, £26,518; increase, £432. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 24th, 1899, were £201 19s.; week ending June 24th, 1898, £109 13s. 9d.; increase, £92 5s. 10d. Total receipts to date, 1899, £4,021 4s.; corresponding period, 1898, £3,156 1s. 7d.; increase, £865 2s. 5d. Miles of track open week ending June 24th, 1899, 8; week ending June 24th, 1898, 8. Car miles run week ending June 24th, 1899, 4,341; week ending June 24th, 1898, 8,415. Number of cars, week ending June 24th, 1899, 11; week ending June 24th, 1898, 9.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 23rd, 1899, were as follows:—D. U. T. Co., horse cars, £2,918 4s. 10d.; ditto. electric cars, £1,275 15s. 1d.; D. S. D. Co., electric cars, £1 085 9s.; total, £4,574 8s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £2 953 19s. 2d.; ditto, electric cars, £579 4s. 6d. D. S. D. Co., electric cars, £761 10s. 10d.; total, £4,294 14s. 6d.; increase, £279 14s. 5d.; aggregate to date, £90,882 8s. 3d.; ditto last year, £85,057 3s. 1d.; increase to date, £5,775 5s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 25th, 1899, amounted to £1,439; corresponding week last year £1,474; decrease, £35.

The South Staffordshire Tramways Company.—The receipts for week ending June 23rd, 1899, were £656 7s. 6d.; aggregate receipts for 25 weeks, £15,826 0s. 7d.; week ending June 24th, 1898, £630 1s. 10d.; aggregate receipts for 25 weeks, £15,101 2s. 9d.

STOCKS AND SHARES.

Wednesday Evening.

A current of uneasiness is the chief thing to be noted in the market for electric lighting shares this week. It first manifested itself with regard to City of London shares. The recent circular issued by the company, giving a full account of its negotiations and correspondence with the Corporation, had the effect of frightening country shareholders to no small extent, and produced the very opposite effect in their minds to what was intended. Shares were thrown on the market, regardless of cost; one unhappy holder sold 50 at 13 in the early part of the week. Since then the price recovered; in fact, it rose to 14½ on the same day. But the "City" incident has left an unpleasant taste in the mouth of investors, and the market, as we have already stated, is restless and fidgety. Charing Cross, contrary to all expectation, shared to some extent in the fall of its discomfited rival, the ground being taken that immense difficulties, Parliamentary and financial, lie in the company's path before it can enter the metropolis. The rest of the electric lighting list has been banefully affected, and for the time being the market is out of all favour. A Stock Exchange axiom that is often quoted, but rarely followed, says that the time to buy is when things are flat. Whether the market is quoting "its lowest summer prices" at the present time we should hesitate to say, but some of its securities look tempting at the reduced prices.

National Telephone shares have been freely bought upon the statement by Mr. Hanbury that mutual concessions are in course of arrangement between the company and the Government. Vague hopes are entertained of an *entente cordiale* which shall release the company from some of the disabilities that are laid upon it in the provinces. Despite the agitation, National Telephone officials state that the number of their subscribers steadily increases, and the report for the half-year will be awaited with more than ordinary interest.

Telegraph descriptions are scarcely mentioned, with the exception of the Anglo-American set. A little speculation for the rise caused an improvement of a fraction in the Deferred stock, and the "B" is sympathising. New telegraphic enterprise has become rather rare of late, but we see from a consular report that a telegraph service is suggested from Iceland to the Shetland Isles. Not much support appears to be forthcoming, and it looks as though Iceland will still have to remain out in the cold.

British Electric Traction shares are a good market, and are overcoming their recent attack of weakness. It is recognised that the company must expect an occasional rebuff in its policy of expansion, and that its being checked in one direction will merely serve to turn its energy into more favourable spheres of influence. Anglo-Argentine tramways weakened, as a seller appeared just before contango-day. The rate for carrying over the shares was 5 to 7 per cent., and 5½ per cent. was freely given by jobbers in the market.

Elmore shares at ⅝—¾ show no reflection of the remarkable interest that has been aroused by the suggestions for amalgamating the interests of the Elmore Companies. The complicated scheme has almost as much to be said in its disfavour as in its behalf, and it is a pity that those who have fought the battle on both sides could not have refrained from undignified abuse in the conflict when so much real business had to be done.

Among manufacturing concerns, Telegraph Constructions are hardest in tone. It is understood that the new German cable will bring some little profit to the company, owing to its possessing the sole right of admitting cables to the Azores. The Machinery Trust's new issues have been well received, but no premium is quotable on either shares or Debentures. Quiet inaction is the only characteristic of the Electric Railway department.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, June 21st.	Closing Quotation, June 28th.	Business done during week ended June 28th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	101 —105	101 —105	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 18s	3 %	£3 9s	60 — 63	61 — 64	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	111 —112	111½—112½	112¼	111¼
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	12¼— 12¾	12½— 13	...	...
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15½— 16	15½— 15⅝	15⅝	15½
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —192	185 —192	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105⅝	105⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	102 —105%	105 —109%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	...	11½— 12	11½— 12	11⅝	11½
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	102 —105	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	...	163 —168	163 —168	165	163
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	100 —104	100 —104	100	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —122	118 —122	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16½— 16¾	16 — 16½	16⅝	16 1/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	100 —104	100 —104	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	120 —124	120 —124	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	101 —105	101 —105	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	11½— 12	11 — 11½	11⅜	11 3/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 15⅝	15½	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31½— 32½	31½— 32½	32¼	...
92,600	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 56	53 — 56	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	4½— 5	4⅝— 5⅛	5⅛	4⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5¼	4⅜— 5¼	5¼	5
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —103	100 —103	101¾	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— 1	⅝— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	5 — 5½	5⅛	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	105 —108	103¾	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¾— 1	¾— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	1½— 1⅝	1½— 1⅝	1½	1 3/16
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,659	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	10½— 11½	11⅜	11
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	112 —114	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	14 — 16	14 — 16	14½	13
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	13 — 15	14½	13¾
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	127½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 12	11 — 12	11 3/16	11 1/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	14 1/16	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	54 — 56	54 — 56	54⅞	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7⅜— 8¼	7⅜— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3¼— 4	...	...
48,030	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6¼— 7	6⅜	6 1/16
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106 xd	104 —106	106	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16½— 17½	...	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	118 —121	118 —121	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16 — 17	16 — 17	16⅜	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	17 — 18	17 — 18	17⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅛	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4½— 4⅝	4½— 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14 — 15	14 13/16	14½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being xred as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation June 21st.	Closing Quotation June 28th.	Business done during week ended June 28th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	3¼ — 3⅜	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17½ — 18½	18 — 19	18⅜	18
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14⅜	14
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13¾ — 14¼	13¾ — 14¼	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128	127¼
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞ — 2⅛	1⅞ — 2	1 15/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2¼ — 2⅜	2⅛ — 2⅜	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	14 — 15	14 — 15	15	14½
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½ — 11	10½ — 11	11	10 13/16
178,303	Do. do. do. £8 paid	10	...	...	...	8½ — 9	8½ — 9	8 15/16	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3 — 3½	3 — 3½	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½ — 6	5½ — 6	...	...
630,000*l*	City and South London Railway	Stock	1 2/16 %	1⅞ %	2⅛ %	67 — 69	67 — 69	67½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅛ — 5¼	4⅜ — 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4¼	3½ — 4¼	4 2/16	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	...	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	97 — 99	97 — 99	98½	97½
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼ — 2½	2¼ — 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105¼	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝ — ⅞	⅝ — ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½ — 25½	24½ — 25½	25¼	25⅛
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	18 — 20	19¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3¼ %	3¼ %	8⅜ — 8⅝	8½ — 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	40⅛	39
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	105 —108	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½ — 10 xd	9½ — 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	5 13/16	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	105 —108	104 —107	106	104⅞

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.
British Aluminium, Ordinary, 10½—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 18.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, June 28th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	33/-	33/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	57/-	57/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a ,, ,, ... per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£27	£27	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a ,, White Sugar .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¼d.	3½d.	..
a ,, Caustic (75/80 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 5	£6 5	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a ,, Crystals .. .. .. per ton	£3	£3	..
a ,, Bichromate, casks .. per lb.	2¾d.	2¼d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b ,, Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £137	£65 to £137	..
c Brass (rolled metal 3" to 12") basis per lb.	8½d.	8½d.	..
c ,, Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c ,, Wire, basis .. .. per lb.	8¾d.	8¾d.	..
d			
e			

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£86	..
g ,, Wire (basis price) .. per lb.	10½d.	10½d.	..
g ,, Sheet .. .. .. per ton	£86	£86	..
g ,, Rod .. .. .. per ton	£86	£85	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/1½	4/0½ to 4/1½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	66/-	64/-	2/- inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i ,, Wire galvanised No. 8 .. per ton	£10 12 6	£10 12 6	..
g Lead, English Ingot .. .. per ton	£14 7 6	£14 7 6	..
g ,, ,, Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	6/8	6/8	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd strip & sheet per lb.	From 1/3½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£120 10	£120 10	..
g ,, foil .. .. per lb.	1/6	1/6	..
n ,, wire Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j ,, Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j ,, Hemp, 3 ply 10 lbs. .. per lb.	5½d.	5½d.	..
j ,, ,, Russian, 10 lbs. per lb.	4½d.	4½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£12	£12	..
j ,, Manila, 24 thread .. per ton	£32 10	£33 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£30	£31	20s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

LIGHT RAILWAY COMMISSION.

LIST OF APPLICATIONS MADE TO THE LIGHT RAILWAY COMMISSIONERS IN MAY, 1899, FOR ORDERS AUTHORISING LIGHT RAILWAYS.

Title.	County.	Promoters.	Engineer.	Mileage.	Motive power.	Gauge.	Agents.
						Ft. Ins.	
ENGLAND—							
Aston, Erdington, and Sutton Coldfield	Warwick.	J. J. Gittings, E. Horton, W. J. Kershaw	Pritchard & Co.	5¾	Electric	3 6	Wm. Webb & Co.
Barrowford and District	Lancs.	Barrowford Urban District Council	J. Mallinson...	1¾	Electric	4 8½	Sharpe & Co.
Bath and District	Somerset.	H. T. Ellis, J. W. Davies, J. F. Hosken	G. Hopkins & Sons ...	17¾	Electric	4 0	Brash, Wheeler & Co.
Bere, Alston, and Calstock	Devon and Cornwall.	Plymouth, Devonport and South-Western Junction Railway Company.	Galbraith & Church ...	4¼	Steam	3 6	Burchell & Co.
Bishops Waltham	Soton.	Finance Mines and Industries Association, Limited ...	H. Mitchell Whitley ...	4¼	Steam	4 8½	Baker, Lees & Co.
Blackpool and Garstang	Lancs.	Blackpool and Garstang Light Railway Company, Limited.	J. J. Myres	14½	Mechanical	4 8½	Sherwood & Co.
Bourne Valley	Soton.	G. T. Harper, T. A. Edney Hayter, S. Clarke and others	J. S. Macintyre	11¼	Steam	4 8½	W. & W. B. Bell.
Brackenhill	Yorks.	Yorkshire District Light Railway Syndicate, Limited ...	Mammatt & White... ...	3	Steam	4 8½	Rees & Frere.
Bridgwater, Langport and Glastonbury	Somerset.	Light Railways Development Company, Limited ...	P. W. & C. S. Meik ...	19½	Steam	4 8½	A. E. Bonnor Maurice.
Bromsgrove	Worcs.	J. Booth, G. Brodie, J. Humphreys and others	Pritchard & Co.	3½	Electric	3 6	Wm. Webb & Co.
County of Middlesex	Middx. and Herts.	Middlesex County Council and the Metropolitan Tramways and Omnibus Company, Limited.	V. B. D. Cooper	25½	Electric	4 8½	H. C. Godfray.
Darlington	Durham.	Imperial Tramways Company, Limited	J. Clifton Robinson ...	9	Electric	3 6	H. C. Godfray.
Dartford District (deviation)	Kent.	International Communications, Limited	G. A. Hubbard	1½	Steam	4 8½	Jordan & Lavington.
Derwent Valley	Yorks.	Escrick Rural District Council and Riccall Rural District Council.	Martin & Fenwick	16¼	Steam	4 8½	Baker, Lees & Co.
Finchley	Middx.	Finchley Urban District Council	F. Smythe	4	Electric	4 8½	A. M. M. Forbes.
Finchley, Hendon, Edgware and District.	London, Middx. and Herts.	Finchley District Electric Traction Company, Limited ...	E. Wragge	26	Electric	4 8½	Wm. Webb & Co.
Fleetwood and Morecambe	Lancs.	A. Bruce, W. L. Knowles, E. B. Nelson	Knowles & Russell... ...	17½	Steam	4 8½	Bircham & Co.
Gateshead and District	Durham.	Gateshead and District Tramways Company	S. Sellon	2½	Electric	4 8½	S. Morse.
Highbridge, Wedmore and Cheddar ...	Somerset.	Railway Developments, Limited	J. Russell	12¾	Steam	4 8½	J. Kennedy.
Knott End Railway (extension to Lancaster).	Lancs.	Knott End Railway Company	B. Sykes	10¼	Steam	4 8½	Baker, Lees & Co.
Lastingham and Rosedale	Yorks.	Lastingham and Rosedale Railway and Estate Company, Limited.	W. B. Myers-Beswick ...	9¼	Steam	4 8½	Baxter & Co.
Leicester, Anstey and Newtown Linford	Leics.	Railway Developments, Limited	H. A. Roechling	6	Electric	4 8½	J. Kennedy.
Leighton Buzzard and Hitchin ...	Bedford and Herts.	W. S. Cooper, J. Waugh, Hy. Green	A. C. Pain	18	Steam	4 8½	Baxter & Co.
London and South-Western Railway (Basingtoke and Alton), amending.	Soton.	London and South-Western Railway Company	W. R. Galbraith	Level crossings.		—	Bircham & Co.
Maidstone and Faversham Junction ...	Kent.	Maidstone and Faversham Junction Light Railway Company, Limited.	H. F. Stephens	12¼	Steam	4 8½	R. W. Cooper & Sons.
Mid Suffolk	Suffolk.	F. S. Stevenson, B. M. Kilby	Jeyes & Godden	50¾	Steam	4 8½	W. H. Smith & Son.
Nelson (Barrowford Branch)	Lancs.	Nelson Corporation	B. Ball	1½	Electric	4 8½	Baker, Lees & Co.
Nuneaton and District	Warwick.	Nuneaton and District Light Railway Company, Limited	A. Wiseman...	8¾	Electric	3 6	Warwick Webb.
Oakington and Cottenham	Cambs.	Power and Traction, Limited	Hy. Ough & Son	4	Steam	2 6	Baker, Lees & Co.
Ormskirk and Southport	Lancs.	T. O. Callender, W. Winnard, A. Wright	R. H. Scotter	6½	Mechanical	4 8½	Sherwood & Co.
Peterborough and District	Northants. and Hunts.	British Electric Traction Company, Limited	S. Sellon	8	Electric	3 6	S. Morse.
Robertsbridge and Pevensey	Sussex	C. A. Egerton, P. R. Papillon, W. K. Stenning	A. T. Barry	15¾	Steam	4 8	J. C. Ball.
Ryde and Sea View	Soton (I.W.)	E. J. Bax, G. Ellis, A. R. Davey	Kincaid, Waller & Manville	2¾	Electric	3 6	Roberts & Co.
South Staffs. (extensions)	Staffs.	British Electric Traction Company, Limited	S. Sellon	2¾	Electric	3 6	S. Morse.
Southwold Railway (Southwold and Lowestoft).	Suffolk	Southwold Railway Company	A. C. Pain	12¼	Steam	4 8½	F. C. Mathews, Browne & Co.
Watford and District	Herts.	J. Fell, S. Hunter, W. J. Kershaw	Pritchard & Co.	8¾	Electric	3 6	Wm. Webb & Co.
Wolverhampton and Bridgnorth ...	Staffs., Salop	J. Heath, B. Melville, H. King, J. T. Firbank	W. B. Myers-Beswick ...	18	Steam	4 8½	Sherwood & Co.
Worcester and District	Worcs.	Worcester Tramways, Limited	Pritchard & Co.	4¾	Electric	3 6	S. Morse.
WALES—							
Aberdare	Glamorgan	British Electric Traction Company, Limited	S. Sellon	3¾	Electric	3 6	S. Morse.
Rhondda Valley	Glamorgan	British Electric Traction Company, Limited	S. Sellon	5¼	Electric	3 6	S. Morse.

Light Railway Commission, *June 1st*, 1899.

HENRY ALLAN STEWARD, *Secretary*.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

Thursday's Convention.

In the absence of the president, Mr. Faraday Proctor, Mr. Rider, of Plymouth, one of the vice-presidents, occupied the chair. Mr. Rider expressed satisfaction that, as their president was away, he was engaged in so good a work as fighting a gas company. Mr. Rider then said he had to call upon himself to read the paper in his name. This was published in our last issue.

Discussion on Mr. Rider's Paper.

Mr. Wordingham (Manchester) said that the question of combined lighting and traction stations was one with which he was completely satiated. He had been steeped in the subject from his own corporation for some months past. He would tell them what they proposed to do in Manchester, and why they proposed to do it. In the first place, he had strongly advocated from the beginning the combination of the two stations. To his mind, if the subject was approached with impartiality, there could not be the slightest doubt as to the advantage to both undertakings of combining the two generating stations. The nature of the problem would doubtless be affected to some extent by the size of the area to be supplied, because on that would depend the system of generation necessary, and also to a great extent the difficulties that had to be met with in dealing with the earth return, assuming, that was, that they were going to use the overhead trolley as had been decided in the case of Manchester. The area they had to supply was very large, about 45 square miles, and some of the distances in a straight line were very great. Therefore, unless one was prepared to put down, perhaps, a dozen generating stations, one was absolutely forced into providing some high pressure scheme. When a district to be lighted was also one which did not lend itself readily to a number of small low pressure generating stations, they were led to the same system of generation, viz, high pressure. He was in favour of the supply of continuous current to consumers for all purposes, but seeing that they must have continuous current for traction purposes, they were led to this position, viz., that they wanted the same system of generation and distribution for both purposes of lighting and traction. That was the case with a large area. If they came to a small area practically the same arguments applied, because if the area was so small that it could be served for lighting purposes by a low pressure generating station it could be supplied with current for traction purposes. But what was the saving that might be received? Even the bitterest opponents of combined stations could not say it would be more expensive to run the two systems if they were housed in the same building. Would it be less expensive? He thought it would. In the first place, by combining the two stations they had one engineering staff, and in that way a considerable saving could be effected. The combination effected a saving in staff and management. When the combined system was employed, such as was proposed in Manchester, the same generators would supply the current simultaneously for both purposes. They had another large saving, because they could use larger generating units, which meant to some extent increased economy, and to a large extent increased saving in the cost of attendance on the plant, to say nothing of convenience, and, he believed, freedom from breakdown. One of the largest savings made was by reducing the stand-by losses. People were apt to speak of the traction load as being absolutely continuous for, perhaps, 12 or 15 hours a day. There were a great many more trams required in the early morning, when people were going to business, and in the afternoon, when they were returning. They had not yet arrived at the position of running trams all night, although it would come, no doubt, for goods traffic. If they combined the two systems, practically speaking, the stand-by losses were halved, for although they had larger steam pipes and more boilers, they had not anything like double the amount of radiating surface. He could not see that any different class of generators was required for the two purposes. It surely required as much care to run a lighting station as a traction station. It was absurd to suppose that the tramway department would be able to give a more reliable supply than the lighting department. Then as regarded the combined stations not being able to produce the current so cheaply as separate stations, he thought it was ridiculous. It could not be more expensive. It must, in his opinion, be less expensive. The average cost of production in a combined station must of necessity be higher than in a purely tramway station, but the cost of producing the energy for both purposes individually would be cheaper—that was to say, it would cost less for traction in a combined station for the traction part of the load than in a purely traction station, and less for lighting in a combined station than for a purely lighting station. Of course, the tramway load must be charged in proportion to its merits; that was to say, they would adopt a system of charge which would give the full benefit of a long-hour load to the tramway. Therefore they must have a compound charge based upon the maximum demand and the cost of actually generating current. They proposed to charge the tramway committee with their proportion of the standing charges, plus a certain sum per unit which would be in proportion to the cost of actual running. He did not agree with Mr. Rider that they should put the tramway system upon the same basis as a private consumer, for this reason—the tramway supply was enormously greater than any private consumer could be. The turnover being greater, the electrical authority could do with a much smaller rate of profit than from the ordinary consumer. Again, he thought, seeing that both departments belonged to the same Corporation, provided no loss was made on the tramway supply, they should not seek to make any profit, or at most, a very small percentage. He saw no object in making a big profit out of the tramway department and handing it over to the relief of rates or of lighting. Each should stand on its own merits; one should not be taxed to pay for the other. They might say it was difficult to distinguish between the two, but he did not think that with a little trouble much difficulty need be experienced. They had to ascertain the stand-by losses, and what were the actual running costs, and that could be done he felt sure.

Mr. Barnard (Hull) said he was told he should be put upon his defence for having two stations in Hull. The question in Hull seemed to depend very largely upon the size of the stations. They might have very small stations, and he was then entirely with Mr. Rider it was essential that the two stations should be combined; but if the stations were of a certain size, it seemed to him the savings from the combination vanished entirely. The saving in staff, for instance. A staff of men could only attend a certain amount of plant, and practically they had reached one shift of men on each of their lighting and tramway stations. As regards the class of generators, they should adopt the same class of generators for tramways and lighting. The argument that the two required a different class of generators he did not agree with at all. They simply put their lighting and their tramway stations in the most convenient area for their own specific purposes. Their tramway centre would not be the most convenient area for the lighting station; the lighting station not the most convenient area for the tramway station. That was partly because he was very strong against the use of high tension for tramway work. They could do their lighting by high tension from some distance, but he should be strongly against using high tension plant for tramway work if they could possibly get a central position for the tramways to use a low tension current. Really what decided them in the end was the question whether they should adopt the high or low tension for the tramways. He could not find any saving in combined tramway stations with the lighting station which would counterbalance the objection of using the high tension system for the tramways. It certainly worked out to his mind more satisfactorily to put the low tension station down, especially for the tramways.

Mr. Chamen supposed he must say something for Glasgow, which was supposed to have fallen from grace. The question in Glasgow had never been considered on its merits as an engineering question at all—not by the Council. There was no opportunity given by the electricity department to make a proper report, and it was evident from the first, upon the general question of expediency, a majority of the Council wished to leave the whole concern in the hands of the tramway department. The tramway department of Glasgow was comparatively an old established one; the Corporation had owned the trams for some years past. The present general manager had undoubtedly managed with great success, and had thereby pleased both the public and the Corporation, and the point of view taken was rather, if he made up his mind electric traction should be resorted to, he should, if he wished, have the whole thing in his own hands. Both the Glasgow tramways and the electric light undertakings were huge concerns in themselves. He, honestly, did not see what advantage could be gained by combining the two concerns in one generating station compared with the disadvantages that would certainly arise in the case of Glasgow. He thought on the engineering question pure and simple it had been a great mistake. It must be evident to everyone it had been a great mistake to put down this one generating station for the tramways. Glasgow was quite large enough, and the general power demands were sufficient to warrant before many years were out four stations. They had a river running through the city. He did not think four stations would be too many eventually. It had been argued in favour of the three-phase high tension system, and, perhaps, rightly to some extent, that it was much easier to get over the fall of potential in the rails in return by using that system with a large number of sub-stations. The Glasgow Corporation were going to use five sub-stations which happened to be the five present horse tramway depôts. That happened to come in conveniently with the requirements of the case. The engineer who reported upon the matter to the Corporation produced figures from somewhere or nowhere, saying it would be a mistake to have five generating stations, and that the right thing was one large station. He thought it was clear in the minds of the Council in Glasgow the great advantage of the high tension system was it could be taken away into the country where the buttercups and daisies grew—a long way from the city. But the Council was one day taken by surprise by having a special printed minute brought up to consider the matter. That minute stated that the committee recommended the purchase of a site for a tramway generating station within half a mile of their own largest electric lighting station and at the same radius from the centre of the city. What was somewhat surprising was that this recommendation was backed by a statement if they were compelled to go further afield there was no other site available at a nearer distance than a mile or a mile and a half. Under all the circumstances of the case it would require something like £20,000 a mile to run the mains from the generating station extra as compared with the site then recommended; and the site recommended was more or less an expensive one. The statement further went on to say there would be a loss of about £300 per annum in distributing from the distant point. From an engineering point of view he did not think Glasgow should stand in the list in which it did stand at all. The whole of the supply within the municipal boundary could be dealt with from four generating stations, and these at the same time could have contained electric lighting plant for their own districts.

Mr. Wilmshurst (Derby) believed that most of their engineer members would be in sympathy with Mr. Rider. The difficulties which beset the question were rather with the members of Corporations. There was among committees a certain amount of jealousy, at any rate in certain towns. Tramway committees in some places

did not like to be in any way dependent upon another committee. There was no doubt that in moderate sized towns they could keep down their cost by combining their stations. Even if they showed no economy in one department, they were bound to show an economy in stand-by costs. The arguments against combined works, when boiled down, did not amount to very much.

Mr. GILES (Blackburn) pointed out that in a combined station the percentage of spare plant was not increased. If they had a combined station there was no reason why they should have more than about 25 per cent. spare, including both the lighting and tramway. But, on the other hand, with two separate stations, the probability was that each would have this amount of spare plant. Mr. Rider was quite right so far as the generating cost went. It must be quite clear that the only increased charges were coal, stores and repairs. They had no increase in the staff owing to supplying the tramways. In an ordinary sized town he did not think they would see that they were using much extra steam plant, and in a town with a small tramway undertaking, the call for steam plant was very much smaller than might be anticipated. In his own town a 120-kilo generator was supplying eight cars on two sections of tramways with considerable gradients and many awkward curves. The average load on this set was about a quarter of its capacity, although, of course, the rise and fall from minimum to maximum was very frequent. This little set was generating about 600 units per day, equal to about 220,000 units per annum. This was slightly in excess of a constant quarter load on the plant for a period of 17 hours a day. They were not steaming any more boilers in the day than before they had the tramways.

Mr. FERRANTI said if the Convention had discussed that one subject alone it would have done most excellent work. This particular subject he felt upon most keenly. He was almost going to say that anyone who looked at this question fairly and rationally could not fail to come to the conclusion that a combined station for lighting and power was the right thing. He was delighted to find there was one gentleman there with whom he most thoroughly agreed—perhaps a great many more agreed with him also, and perhaps a great many more held his views. He thought what Mr. Wordingham had recommended for Manchester, and the system he had proposed, was the right thing. If there was any good argument which could be supported for dividing the systems or dividing the business, he said that was simply a mark of the want of proper conditions or of the fulfilment of proper conditions in the plant originally installed. If it was said the two businesses should not be put together it showed that the first installation for the lighting had not been laid down on the best lines for general business. Although there had been many arguments raised, which seemed to be good arguments, in favour of there being no advantage to be gained by having a station larger than a certain capacity, he, with his limited and selfish point of view, could not conceive the business which was so large that it could not be more economically effected from one central establishment than divided up into a sort of retail business all over the town. He had been almost knocked out over one expression which he heard from Mr. Barnard. He told him he was using high tension for his lighting, but that he did not think it would be desirable for tramways as well. Now, if there was one thing which, rightly or wrongly, he did think was in favour of high tension, it was that it might be used for a large area, and meeting all the demands which could be put upon it. The first thing which struck him many years ago with regard to the cost of the electric light—it was in the dark ages of electric lighting—was that they with the electrical business could not compete satisfactorily with gas, because they had not a system of supply and distribution which was anything like so flexible or capable of going over so large an area as the gas company. It was these reasons which led to the inception of the attempts at electrical supply from Deptford, and which convinced him that the right thing to do was to follow their most successful rival the gas business. The point was further emphasised by the fact of their having another outlet for the current, another splendid business before the electrical industry, viz., traction. In his opinion their generating station should be such that it should be placed in the most convenient position for taking water in, and that that central generating station or general supply station should be capable of filling every requirement of the community which required the supply. There was one thing which militated very much against this combined lighting and power plant, and that was a thing which so long as they went on they would never eliminate by superior education, and not until more common sense and good feeling were brought to bear. He referred to the jealousy of one committee over another, which was sometimes fostered and worked upon for private ends. Suppose, for example, that the Tramways Committee was not satisfied that its system was worked to the best advantage by taking its current from the Electrical Committee, his business was to give the best advice he could. He saw the committee, and they said, "Will electricity cost as much for tramways as for lighting?" He said, "Dear me, no; of course it will not. It will cost a fraction of a penny for tramways, and the best price at which it is possible to do it in the biggest station for electric lighting is several pennies per unit. How can any of you think it would pay to run tramways with electricity at that price?" If he might go back to a technical detail—he believed Mr. Wordingham raised it—he would refer to the question of stand-by losses. They were, no doubt, a most serious expense. He ventured to say, notwithstanding the great knowledge which his hearers had of the details of a station, being there every day, they perhaps hardly realised as much as an outsider what stand-by losses meant. He was taking the opportunity to remind them of the fact, and what it came down to was this, if by having these two stations they could reduce their standing losses they saved a very great deal. They had to run the tramway business, say, all day long; they got their lighting or stand-by losses, which he thought were almost the principal cost of the lighting, thrown in, and there was a very great and undoubted advantage to be got under that head. The question of stand-by losses was being carefully gone into and very much reduced. He hoped they would think this matter over and not try to theorise too particularly upon it. They should not, perhaps, take too many figures, but try to look at it from the outsiders' common sense point of view, whether they could sell stuff better with several establishments, or by doing the same turnover from one. He was sure they would come round to the view of those speakers who had advocated the combination of all the businesses of electrical supply within one station if possible.

Mr. CHAMEN explained that at Glasgow one station would accommodate 30,000 horse-power, another 15,000, and so on. The case for one big generating station, as far as he was able to judge, was gone in a place like Glasgow. It was far too big.

Mr. FERRANTI: That is a matter of opinion.

Mr. ARMSTRONG believed that this question resolved itself mainly into one of conditions, and they must not force conditions to meet their particular views. It seemed probable that a common supply would be more economical and desirable, but in certain special cases separate generating stations would be preferable.

Mr. QUIN (Blackpool) said it seemed to him that the question of combining could be looked at from three points of view. First, from the lighting station point of view, and there was no doubt from that point of view it should be combined. From the tramway point of view they wished to have a separate station. If they represented a town they could give but one decision, and it was, from the point of view of the town, they must combine. The total expense per unit undoubtedly was lower in combined working. It was really upon the whole question they must decide. Mr. Wilmshurst mentioned something about jealousies of committees giving rise to separate generating stations. They got over that difficulty at Blackpool by giving the whole thing to the same committee—they combined the committees. They had an electric light and a tramways committee, and that committee controlled both undertakings. They found a considerable saving by combination. Although the electricity branch was making a fair profit by supplying the tramways, the cost of the tramway department had been considerably less than previously. There was the same amount of steam piping, the same amount of radiating surface entirely. They had the same boilers, although they had to run additional generating plant. He did not agree with the author of the paper on the question of accumulators. He had not much faith in them, and where the time of discharge at anything like a high rate was lengthy, then the cost of these batteries was much greater than the cost of equivalent generating plant. He was agreed that if the discharge was only of short duration the price of the batteries per kilowatt was the same as boilers. If the discharge was lengthy the cost was considerably higher and the arrangement much less efficient.

Mr. SNELL (Sunderland) said Sunderland had decided to combine the lighting and traction undertakings. He congratulated Mr. Rider on the pertinacity with which he had pegged away at this problem. Mr. Quin was the only speaker who had touched on the use of accumulators. He (Mr. Snell) could not see what great use batteries were going to be in traction stations. Mr. Quin mentioned that the cost of batteries was practically equal to the cost of engines and boilers. He could not make that out. The cost per kilowatt was practically the same as the steam dynamo without boilers. He did not think there was going to be much saving with regard to staff by combination. Stokers, &c., could only look after a certain amount of plant. With regard to managerial costs it was a totally different thing. In a majority of towns the office of tramway and lighting engineer was being combined in one person. No doubt he would have assistants in charge of various departments, and combination must result in a material saving. He did not see otherwise where the saving was to come in. With regard to stand-by loss there would be a certain saving, but he thought the saving was not going to be so great as was made out. If they had a system of direct current supply, if they adopted their batteries on their lighting load so as to fill up the valleys in that lighting load, he thought they were all aware the effect must be a considerable saving in cost—he did not say at the present moment, because the cost of batteries was so exceedingly high—the cost of maintenance. It was a point they frequently overlooked, that the life of accumulators was not more than 10 years. They borrowed money for 25 years, and, therefore, the capital charges upon accumulators were 2½ times the charges on the rest of the plant. Then the efficiency of batteries was so exceedingly low. In taking the lighting load, the efficiency of batteries was not more than 65 per cent. They might get 80 per cent. in a test, but working on a variable lighting load they would find the efficiency was not greater than 65 per cent. Although Mr. Rider put in a good case for the use of accumulators, the day had hardly come yet for their extensive use. He thought he would be a bold engineer who went in for them in a large scheme.

Alderman MILLINGTON (Hull) said that many of them were connected with old towns and cities, and their lighting plant was a question of growth from very small stations. The question of tramways had come up in after years, therefore it had been a question of providing a power station rather than a question of the economical working of the whole. At Hull they had had that difficulty. They commenced with a small scheme, with their first station in a limited area. They commenced in the best part of the town in the hope of making it a success. They had had to grow and to extend the system from that very small area. If they got to the centre of a town they were hampered by the difficulty of getting a site of the size they would like, and they were hampered also by the high price of land in the centre of a large city. They had established, as he had said, the system of lighting before the other, and recently they had taken up the tram question, and had to consider which was the best for carrying on that part of the undertaking. As a member of the committee of the tramways and the

electric lighting committee, he had not found that jealousy that had been hinted at in that meeting. Members of both committees were on each committee, and also the officials were connected with the tramway committee. They submitted the matter to the judgment of experts. The experts submitted a scheme, and of course the Hull Councillors accepted the experts' views, with the result they had two separate stations, one for lighting and one for the tramways. The town was in the form of a half-circle, and it was necessary to place the station for power at the centre of the base, so that the mains might branch off in all directions. In Hull it was mainly a question of expediency; they did not want to delay the introduction of the tramway. They might have spent a lot of time discussing the question, but were anxious to get the tramways in operation as early as possible.

Mr. Calvert (Huddersfield) said he represented one of the towns which had adopted the separate system. He seemed almost ashamed of himself for the action they had taken in Huddersfield. There the question of combined or separate stations arose when they had a change in the officials. They had a tramways manager who had managed very well the horse traction. The electrical engineer was instructed to draw up a report, and while he was away on his holiday last year the tramway manager found out it was necessary that the report should be presented at once. After that it was thought by some members of the Council, who were supposed to know a great deal about electricity, that perhaps neither gentleman was the proper one to decide, and it was agreed to refer the matter to somebody else. In addition to being chairman of the Electrical Committee, he (the speaker) was a member of the Tramway Committee, and the question was relegated to a small committee, who spent a good deal of time making inquiries. When the report of the borough engineer came before the committee, the voting for and against a separate or combined system was equal, and the chairman of the Tramway Committee gave his casting vote in favour of separate stations. At the time the report was presented Glasgow were employing an expert to report upon whether separate or combined stations would be the best, and he got a resolution passed in committee deferring consideration of the matter until the report had been presented to Glasgow. They agreed to adopt the report afterwards of the borough engineer, because Glasgow had agreed to adopt another report, and about the only analogy between the two reports was that they were both agreed on a separate station. Only the previous day there was a Local Government Board inquiry held at Huddersfield, and he saw from the newspaper—it was into the application of the Tramway Committee for a provisional order—that one of the first questions Major Cardew, who was conducting the inquiry, asked was: "Why are you not working this system in combination with electric lighting?" He was firmly of opinion that although Huddersfield had agreed to go in for a separate system before they commenced—nothing had been done so far in electrical equipment—something would be done, and eventually the thing would be worked from a combined station.

Alderman Woodhead (Halifax) said there was a unanimity which was refreshing to Halifax, which had a combined station. Their tramway undertaking was only a young one, yet its success had been phenomenal. Their electric light undertaking was somewhat older, now nearly five years, but the two were progressing together and both were a very great success. They could appreciate the remarks made by Mr. Ferranti. He was especially pleased, seeing that one whose interest was to provide as much plant as possible all over the country had sufficient self-denial to advocate a cause which he thought best, and to recommend a combined station. When they commenced all Halifax people thought they were wild in the extreme, but under the excellent advice of their then engineer, Mr. Wilmshurst, they provided not for the day, but the future, and they had a station at the present time which would supply their wants for the two purposes for some time to come.

Mr. Ellis (Bolton) said that they were laying down 30 odd miles of track at Bolton, and they expected to open at the beginning of next year. Having decided on the tramway system, they had also decided to change over their lighting system to the continuous current, and the same plant was going to do for both purposes. In that way the amount of spare plant would be cut down to a minimum. He thought Mr. Rider's paper was chiefly for advocating the use of batteries. Speaking for himself, he was quite prepared to wait and hear his experience after. His experience of batteries had been a very expensive one, and for that reason he was not prepared to advise his committee to go in for a large expense at the present time. As to the price to be charged the tramway department for the current, he could not think that they should be charged at the same rate as a lighting customer. The tramways were a customer that could give them a load of 12 to 14 hours a day, and they ought to supply them at the lowest possible price. The lighting customer was different altogether. Taking the churches as an example, the average use of current in a large church did not come up to an hour a day for the whole year. It was a great deal less than that, and they could not expect to charge them on the basis that applied to tramways which were using the current thousands of hours in the year. He thought instead of using batteries it would be a great deal better to cater for the public and do away with the necessity of having to use batteries by getting a day load for motors for private purposes The object of changing over in Bolton to the continuous current was for that sole reason, and they had promises for 700 horse-power for motor purposes during the daytime.

Mr. Rider, in reply, said he was pleased to find that there was a practical unanimity of opinion. The points raised by various members against combined stations had been more or less answered by other speakers. Mr. Quin had raised a point as to the cost of batteries compared with steam plant, and for a lengthy discharge. It depended on what he called a lengthy discharge. His own experience had been that batteries for a five hours' discharge, which was long enough to take any ordinary peak, cost the same as steam plant; that was to say, both engines, dynamos, and boilers, and the advantage of batteries was chiefly that they gave a 24 hours' load, which was best for their steam-raising plant. Without the batteries they could not get a 24-hour load, although they might be working their engines at a high efficiency. When they were on with the batteries they got a 24-hour load for boilers and steam pipes. Mr. Ellis had mentioned the methods of charging, and the iniquity of charging the tramway committee on the same scale as other customers. To his mind, there was no iniquity at all in it, because it depended entirely upon what the scale was, and how they carried out the charges. The initial price must be high, that would be the maximum, but the bottom price should be as low as they liked. It seemed to him that with a 15 or 16-hour load every day the Tramway Committee would of necessity get within a fraction of a penny of the bottom price. If they were charging all their consumers on the same basis, those who used it longest were bound to get the best price. There was no unfairness in it that he could see, because if the system was properly arranged they were getting their current on equitable terms.

Mr. Ellis asked if they got within a fraction, why trouble at all? If they had an hour at 7d. and 13 at a 1d. a unit, probably they would all work down to an average of 1½d. Why then go to the maximum at all?

Mr. Rider: It is simply a question of having the argument that everybody is served alike. If you go to the consumers and they say you are charging me a higher price than you are charging the tramway committee, it is met by the argument "You are all served on the same scale."

Mr. Ellis: I don't see that, Mr. Chairman, for this reason—because you know what number of hours the tramways are using the current, with your customers you don't.

Mr. Rider: We will not argue it now.

THE MUNICIPALISATION OF THE TELEPHONE.

By A. B. Mountain, M.I.E.E.

Borough Electrical Engineer, Huddersfield.

In preparing a paper upon this important subject the author feels he is dealing with a question which has lately received the most careful consideration of many eminent authorities but, unfortunately, the result of much deliberation and inquiry has not led to that unanimity of opinion which may be considered desirable.

Parliament has decided that municipalities shall have power to undertake the management and development of telephonic matters.

The Treasury minute dated May 8th, 1899, upon the proposals for the development of the telephone system in the United Kingdom clearly indicates the policy proposed by Parliament and forms the foundation upon which any scheme for municipalising the telephone system must be based. A copy of the Treasury minute is attached to this paper.

It will be noticed that a general Enabling Act has been introduced in Parliament to give power to local authorities to borrow money to establish telephone services, which will save each municipality the cost of promoting a Bill for the purpose, and will also allow the work to be commenced almost immediately, which is a matter of considerable importance.

The licenses will be granted by the Postmaster-General and will contain a provision that the local authority licensed shall connect their exchanges with the Post Office in order that persons using their telephones may, on payment of the usual charges, speak over the trunk lines, or to post office, or call for the services of express messengers.

Call offices will have to be established at post offices.

If these provisions are carefully attended to and thoroughly advertised, they will add very much to the value of the system.

In accordance with clause 8, conditions will be attached to a license so that the Postmaster-General shall approve:—

1. The character and construction of the plant.

2. The system of charging, and make other regulations which will be to the advantage of the local authority who will have the greatest interest in co-operating with the Post Office.

For several years great efforts have been made to improve the telephone service of the country, the first step being the purchase of the trunk lines by Government from the National Telephone Company, but this has not led to any noticeable improvement or reduction in the charges to subscribers. It is one of the most usual complaints of the telephone subscriber that the trunk service, or service between towns, is not of the value it should be, because of the difficulty in getting through communication, due probably to there being too few wires. It is also a general complaint that the time allowed for each conversation (three minutes) is too short. But the real point attacked has been the question of price, the fixed charge of £10 being prohibitive for all but a small percentage of business premises. Unfortunately all efforts to obtain a reduction in the price have hitherto failed, and hence the development of the telephone system has been retarded, and has led to the introduction of an immense number of private lines which are not connected to any exchange, and are therefore, of very little general use, and which would certainly not have been erected as private lines if the price had been considerably lower. In the present system of charging in force in the United Kingdom, no difference is made between the subscriber who calls 100 times per annum and the subscriber who calls 10,000 times; in fact, the present system of charging is very similar to the American method of charging for electricity at so much per lamp per annum, instead of charging, as in England, for the actual quantity of energy used. This method applied to the telephone puts the small would-be subscriber in the most unfortunate position, and the author hopes to prove that the

charge to subscribers may be very much reduced if the telephone service is controlled by the local authorities.

It may be urged that the telephone service would be better in the hands of a Government department, or controlled by a private company, but there are many good reasons why the local authority should be in a better position to control such matters, for example:—

1. The local authority is responsible for the maintenance of streets, and should, therefore, be responsible for the carrying out of any work which will greatly disturb the streets.

2. As the owners of street and public properties the local authority will not have such difficulty in obtaining wayleaves, as would a Government department or private company.

3. The service being to a very large extent local, it is reasonable to suppose the local authority will more accurately know the requirements of, and be more easily influenced by, local conditions.

4. The healthy competition between the various local authorities which has led to the rapid advance of electricity undertakings will also be a strong factor in helping forward telephonic undertakings, and such competition will be certain to lead to reduced charges and high efficiency.

5. The increased use of the telephone will be of great assistance to the local authority as guardians of peace and property, as notice of fires, robberies, &c., may be instantly forwarded. At present the telephone system is, in most towns, supplemented by a special system of police call boxes, which involve additional and unnecessary expense.

6. As local authorities are now, in many cases, responsible for the supply of water, gas, and electricity, and have tramways and other large undertakings under their charge, they can naturally assist in developing the telephone system by connecting up the offices of their various departments and chief officials.

In the author's opinion, nationalisation would practically represent stagnation, as there would be no competition, no local control, and no inducement for the local authority to assist in developing the system. It is also generally admitted that the efforts of a company would be even less successful than the management by the State, chiefly owing to the difficulties a company would encounter in arranging wayleaves.

The main point the author desires to emphasise is the urgent need of development. Appended to this paper are tabulated returns from other countries, and from these it will be seen that the British Isles are very far from being in a satisfactory position, and that the telephone is, comparatively speaking, a luxury, used by the few who can afford the present high rate of charge. It may be interesting to examine the figures representing, approximately, the state of development in one of the telephone areas, containing a population of about 150,000.

Capital Expenditure.

Cost of connecting 5,975 subscribers, including Central Exchange Trunk Line switchboard, five suburban exchanges, 25 public call boxes, and all overhead and underground work to make the exchange in every way complete	£120,000 0 0

Revenue Account, No. 1.

Income.		Working Expenses.	
By fixed charge of £3 per annum to 5,975 subscribers	£17,925 0 0	To salaries, wages	£8,500 0 0
„ 1,000 calls each at ½d. per call = £2 1s. 8d. for 5,975 subscribers	12,447 18 4	„ Rents, rates, and taxes	1,950 0 0
„ Receipts from 25 public call boxes, 3,000 calls each at 1d. per call	312 10 0	„ Wayleaves and repairs	3,000 0 0
		„ Miscellaneous expenses	550 0 0
		Balance—being gross profit	16,685 8 4
	£30,685 8 4		£30,685 8 4

Net Revenue Account, No. 2.

Balance from revenue account, No. 1...	£16,685 8 4	Interest at 3 per cent.	£3,600 0 0
		Sinking fund contribution, 3 per cent. = repayment in 25 years	3,600 0 0
		Post Office royalty, 10 per cent. on gross revenue ...	3,068 0 0
		Balance carried to depreciation and reserve fund account	6,417 8 4
	£16,685 8 4		£16,685 8 4

Tabulated Statement from the Report Respecting the Telephone Service in Various Foreign Countries.

Issued by Parliament in March, 1899.

Name.	Population.	No. of subscribers.	Method of construction.	Rates charged.	Capital outlay per wire.	System worked by.
Vienna	1,400,000	10,573	Overhead and underground single and double	£8 6s. 8d.	...	State
Trieste	163,979	1,020	Single overhead	£8 0s. 0d.	£18 0 0	State
Prague	320,865	2,200	Single overhead	£5 0s. 0d.	Not known	State
Munich	430,000	4,266	Overhead and underground single and double	£7 10s. 0d.	£33 0 0	State
Stuttgart	158,321	3,363	Single overhead and underground	£5 0s. 0d.	£26 0 0	State
Ghent	200,000	900	Double	£7 18s. 4d.	...	State
Berlin ... ... (Suburb) ...	1,677,304 2,314,451	28,705	Overhead and underground single	£7 10s. 0d.	£22 0 0	State
Frankfort-on-Main	229,279	3,909	Single overhead and underground	£7 10s. 0d.	£22 18 0	State
Leipsic	398,448	4,294	Single overhead and underground	£7 10s. 0d.	£19 2 0	State
Cologne	321,564	3,784	Single overhead and underground	£7 10s. 0d.	£19 12 0	State
Hamburg	681,632	12,064	Single overhead and underground	£7 10s. 0d.	£23 0 0	State
Rome	500,000	2,102	Single overhead	£6 14s. 0d.	...	Company
Florence	250,000	900	Overhead double	£6 8s. 0d.	...	Company
Amsterdam ...	500,000	1,925	Overhead and underground double	£7 10s. 0d.	£33 6 8	Municipality
Berne*	53,000	2,025	Single and double overhead ...	£4 1s. and £2 16s. 1st two years respectively, and £1 12s. succeeding years	...	State
Zurich	157,000	4,400	Double overhead	£4 1st year, £2 16s. 2nd year, £1 12s. succeeding years	...	State
Geneva	58,700	3,264	Single and double overhead and underground	£4 1st year, £2 13s. 2nd year, £1 12s. succeeding years	...	State
New York... ...	1,500,000	20,937	Double underground	£15 10s. to £49 10s.	...	Company
Rotterdam ...	295,000	1,320	Double overhead and underground	£7 10s. for business; £5 10s. private subscribers; £1 13s. 4d. entrance fee	£45 0 0	Municipality
Helsingfors ...	80,000	2,800	Single overhead	£5 if instrument is hired; £3 10s. if bought	...	Company
Stockholm ...	271,638	12,899	Double overhead and underground	£4 8s. 10d; entrance fee £2 15s. 6d.	£20 3 0	Company
Christiana... ...	200,000	6,475	Overhead single and double ...	£4 8s. 10d.	£12 0 6	Company
Bergen	70,000	1,800	Overhead single	£3 13s. 8d.	£13 0 0	Company

* ½d. charged for any conversation.

In this area there are about 600 subscribers who make about 24,000 local calls per week, or 2,080 calls per subscriber per annum. Very few residences are connected, consequently the calls per subscriber are very numerous, whereas if the charges were reduced residences and small shops would also become subscribers. This would reduce the average of calls per subscriber, would reduce the cost of attendance at the exchange, and would make the system of much greater value.

Last year the author had the pleasure of staying a few days at Montreaux, a most pleasant spot on the banks of the Geneva lake, and had the curiosity to inquire the population and the number of telephone subscribers.

He found practically everyone of any importance was connected to the telephone, including a very large number of working men. In England it would be very difficult to persuade a committee to connect the whole of the electrical staff employed by a corporation, because of the prohibitive fixed high charge, whereas in many places on the Continent, as will be seen by reference to the attached tabulated returns, the charge is very low. Take the example, just mentioned, in Montreaux. Ten officials could be connected to this exchange at an annual cost of £16, or £1 12s. each, plus 5 centimes, or, say, ½d. per call, which, allowing 500 calls per annum each, would equal £10 8s. 4d., or a total of £26 8s. 4d, as against a charge of £82 demanded in England.

While most local authorities are making efforts to improve and cheapen the telephone system, the author thinks many are hesitating at municipalisation fearing the financial results may be unsatisfactory, and cause a further burden to the rates, especially if the charges be considerably reduced. The author thinks the immense importance of developing the telephone is fully recognised, as is also the fact that the local authority is responsible for providing a system so necessary to commerce, but, unfortunately, many of the figures which have lately been considered are so at variance, that it is extremely difficult for even an expert to select the right from the wrong. The author has prepared the following estimates, from which, it will be seen, that even with a charge as low as £5 the financial result will be perfectly satisfactory.

Estimate of Capital, Expenditure, Working Cost, and Revenue.

The author has prepared an estimate of the cost of constructing and working a telephonic system, having 5,975 subscribers, five suburban exchanges, and 25 public call boxes, which estimate is attached hereto. It will be seen that at the average price of £5 1s. 8d. per subscriber, there would be a balance of £6,417 8s. 4d. available for the purpose of reserve or depreciation. The figures given may easily be applied to a smaller system, where the results should be in about the same proportion.

In preparing the estimate, the author has carefully consulted existing records, and would point out that in nearly all cases where the capital outlay exceeds £20 per subscriber, the cost has been increased by reconstruction and preliminary investigations, which are not now necessary, since a local authority can easily obtain advice, and put down a system for the amount stated, which will satisfy the Postmaster-General, and without incurring the risk of having to reconstruct in a few years.

Nearly all the existing records include the cost of first constructing single wire overhead systems, and then converting these to either metallic overhead or metallic underground circuits. In such cases the first cost has been enormously increased, so that the figures are now of very little value. A further reason for the high capital outlay recorded against some of the systems is due to the cost of renewing instruments, or even the complete re-equipment of exchanges.

The method of charging should be most carefully considered; it will be noticed the author proposes a fixed charge of £3 per subscriber, with a further charge of ½d. per call; in the author's judgment, it is most desirable to reduce the first charge as much as possible, in fact, to a figure which will just cover standing charges. If that is done more subscribers will be connected, and it is, of course, apparent that the utility of the system will increase in proportion to the number of subscribers; also, that the number of subscribers will increase as the fixed charge is reduced. It would be advisable to fix the charge to cover the whole area instead of to charge an increased rate to those subscribers who happen to reside a considerable distance from the exchange.

Objection may be taken to the 25 years allowed for repayment of capital, but the author has considered this matter in conjunction with Clause 11 of the Treasury minutes referring to purchase by the Postmaster-General, and thinks 60 per cent. of capital cost may reasonably be expected, particularly if ample provision is made for depreciation.

It is also almost impossible to consider this question of repayment of capital and the purchase clause without considering the future policy of Parliament, and it would be reasonable to suppose that if municipalities devote their usual energy to the development of telephones, and are successful, as there can be no doubt they will be, that the Government may probably be persuaded to leave municipalities to continue their good work indefinitely, in which case the purchase clause, with its conditions, will have fulfilled its functions by assisting to keep the telephone finances in a sound condition.

Equipment of System.

In arranging for the installation of a telephone system, local conditions must be most carefully observed, particularly in the selection of the positions of call boxes and suburban exchanges; no two areas will be quite alike, and the number of call boxes and suburban exchanges will depend not only upon the population, but to a large extent upon the size of the area supplied. It should be remembered that about 95 per cent. of the calls will be local, the remaining 5 per cent. being trunk wire communications.

In arranging the trunk line switchboards and junction lines to the Post Office, it will be sufficient to allow one pair of wires for 40 subscribers, or for an exchange having 5,975 subscribers, say, 150 junction wires. Ample allowance must also be made for junction wires between the central and suburban exchanges.

The selection of the switchboard will be a matter requiring great care, as the success of the whole system will depend very largely upon its design and construction. Some form of multiple switchboard will no doubt be provided, of which there are, fortunately, several excellent makers. The report respecting the telephone service in various foreign countries, issued by Parliament in March last, gives much useful information, including the names of the manufacturers from whom the telephone appliances used in the various foreign countries have been purchased.

All circuits must be metallic, and the wires should, as far as possible, be underground, excepting in the outlying districts, where a smaller number of wires will be required, and where they may with advantage be carried overhead. Although the expense of putting wires underground is higher than erecting the same overhead, the cost of maintenance is considerably less, and a far more reliable service can be given. Overhead wires are liable to be injured by snow, wind, and frost, which elements account for very many of the faults so often a source of annoyance with the existing system. The wires are frequently in the way of building alterations, and have to be suddenly removed, causing an interruption to the telephone service, or the owner of certain property will not allow the supports to remain; in fact, with overhead wiring, the interruptions must be numerous, and therefore the service must seriously suffer.

If the wires are drawn into 3-inch cast-iron pipes laid under the roadway or footpath, care should be taken to ventilate junction boxes, so that gas may not accumulate and cause explosions. For the purpose of drainage it will, in most cases, be sufficient to build a brick junction box without any bottom, so that water may soak away.

When laying out the system of underground pipes, it will be necessary to decide whether each pair of wires to a subscriber shall be carried entirely underground, or if the pipes shall be laid to certain centres, and from there distributed overhead to the subscribers in the immediate neighbourhood. The latter course, the author thinks, will be found both the cheapest and best, and it will not be difficult to divide the area to be supplied into sub-areas, each supplied in this manner.

In many towns it might be possible to carry the wires (which would be made into the form of a lead-covered cable) in the main sewers; this would obviate disturbing the surface of the road, and would very much reduce the capital outlay. As the wires would not require removing very frequently, all jointing being done at manholes, the interference with the sewers would be very slight after the wires were once fixed in position. From experience the author has had with lead-covered electric lighting wires in sewers, he does not anticipate any serious deterioration of the lead. Another method, which has at any rate been discussed, is that of running the wires in hollow carbstones made of Doulton ware or cast-iron, but the expense of this method would probably stop its introduction, except for those streets in which difficulties might be met with in laying pipes. The author looks forward to the time when a discussion may take place upon these and many other details, both of construction and management, together with a comparison of financial results, and hopes that very many Corporations will come forward and help on the telephone development, so that the disgrace of being considered behind the whole civilised world may be removed.

[Here follows in the paper a copy of the Treasury minute, dated May 8th, which has already appeared in the Electrical Review.]

Discussion.

Mr. Boot (Tunbridge Wells) presumed that the question of the municipalisation of telephones in most towns would come within the province of the electrical engineer of the town or city. Mr. Mountain, in his excellent paper, had taken up more the question of policy than of technical details. It was the intention of the Corporation of his town to take the assurance of Mr. Hanbury and his committee that before very long licenses would be granted to corporations to undertake the work. The point he would like to raise was the question of the Government undertaking the work instead of local authorities. There were many reasons why the Government was not a suitable authority to do that work. They had had an example, unfortunately, of serious blundering on the part of the Government in the telegraphs. Those who had read the early history of telegraphy, and especially where it was paid for by Government, and remembered the number of messages now sent per head of the population, could not be other than ashamed to find that both financially and in efficiency the Government had blundered. Then, again, a further very strong reason why a local authority should undertake the telephones was undoubtedly the fact that 95 per cent. of the messages—and in many towns an even greater percentage—were purely local, and would have nothing to do with trunk lines. It had been demonstrated in electric lighting, waterworks, gasworks, and it would be shortly in tramways that the best authority for the management of a business which, to be a success, must be a monopoly, was the local authority, and there was no doubt that if the local authority undertook telephones, they would be able to manage them in as successful a manner as they had their other undertakings. What would happen if the Government undertook it? There was an agitation in the country for the purpose of compelling the Government to undertake it out of the hands of Mr. Hanbury—so to speak—and to put it under Government control. The Government started three exchanges in the North of England, in direct competition with the National Telephone Company. What was the result? After a very short time the National Telephone Company practically wiped out the Government

entirely, for the very simple reason that the Government did not attend to small complaints. Their work had been too large for them to attend to a subscriber who might write perhaps to the headquarters to say on such a day he could not get through to So-and-so. It would take probably at the present rate at which the Government took notice of these letters 18 months to get a reply, and then it would be an acknowledgment of the receipt of the first letter. In the trunk lines they had an example of the Government management of telephones. They would bear him out in saying on these trunk lines—personally he used them two or three times a week—he never found he was able to get on under a quarter of an hour. He had had to wait four hours sometimes. He had known what it was to ring a person up in the morning and to be put through when he had gone to lunch, and then when he told them that he could not get his message through, that he was not there, they had the audacity to send in a trunk line charge. There was no means of getting out from that sort of thing if it was in the hands of the Government, but put it into the hands of a local authority and what could they do then? They knew what was the usual thing in electric lighting if only an engineer was unfortunate enough to have an arc lamp out. He heard of it before the week was out from 20 or 30 councillors, and naturally arc lamps went out rarely on account of that circumstance. Complaints did receive some consideration, and it was for that reason the efficiency of the supply of electricity had gone ahead by leaps and bounds. They did not like these complaints, but, said Mr. Boot, "They keep us up to high water mark." It was rather against the local authority taking up the question of telephones that the Government had once or twice stated that they would not grant licenses for more than 11 years. There would probably be a year or two before they got into working order; that would only leave nine years in which to pay off the whole capital. This, however, was not exactly the case. Before the Government could buy up the telephones from the municipal authorities they would have to consult members of Parliament. They would have to obtain the sanction of members of Parliament, and it was well within the knowledge of most gentlemen their local authorities could almost entirely govern the policy of their members of Parliament. If a local authority had a good business working satisfactorily, they had only to bring pressure upon members of Parliament to compel them to vote against the Government acquiring the telephones. He did not see why in the present instance Government should demand a royalty from municipal authorities. Ten per cent. royalty did not amount to much, it was true, but he ventured to suggest that if the authorities undertook telephones at a reasonable rate, and treated subscribers in the way they had been doing consumers of electricity, they would find it would not be one in every thousand who was a subscriber, but one in every ten. In the town he represented they had at the present moment, on the National Telephone system, one in 120. He had already at his office promises that if they started a municipal telephone at the rate of £5 per annum—a rate which, as Mr. Mountain had so ably set forth in his paper, would return a handsome profit—he had already 500 he could connect at once. The National Telephone Company was not altogether to blame for its excessive charge. It was more because of the blundering of the Government in the early days they adopted excessive charges. That caused the necessity for their watered capital. They had restrictions which were not calculated to induce them to connect subscribers at a cheap rate. They had had a good innings, and should now allow competition to assist them in reducing the charge. There was another technical detail. They would notice that the Government only intended buying such plant as they considered efficient at the day of purchase—not efficient to-day. If an invention came out the Government would say, "We will go in for the new instead of the old." There was a new system coming out now—it was used in 10 or 12 towns in the United States—it was known as the automatic system. That system most were aware required the use of metallic circuits, using the earth as a third wire. The customer wishing to call up a number instead of calling up the exchange, simply put himself on to the number he wished to speak to. It was a fairly simple matter. It was simply done by electrical impulses. The subscriber on his instrument had a disc with different numbers. That disc revolved to different numbers, and when it agreed with the number required an impulse was transmitted to the exchange. He did not want to advocate the system too much. There was shortly to be a company floated. It was not yet tried in England. It might be a good thing, or not. He simply mentioned it for what it was worth. Undoubtedly the system mentioned in the paper—all systems, in fact—must be put on metallic circuits. The earth return would not do for working telephones any longer.

Mr. Chamen (Glasgow) claimed for Glasgow that it took the lead over this telephone business. He did not think he should be able to say much in favour of municipalities undertaking the work themselves, but that he was sure was due to his not having fully considered the subject. He thanked Mr. Mountain for bringing the subject before them. It seemed to him one of the objections to the municipality undertaking the telephone exchange was that the licenses should only be granted for 11 years. Mr. Boot seemed to go beyond it altogether, and to suggest that having got their foot in they should throw it upon the Post Office. If that could be done it was a totally different question to that of upsetting the National Telephone Company's exchange by competing with it. A municipal exchange which could only run for 11 years would result in nothing but confusion; therefore, he had not bothered himself with it. He thought the remarks of Mr. Boot went to show that the whole trouble was caused through the Government ever having had anything to do with telephones. Telephones were not anything like telegraphs. The greater part of the duty at the telephone was local. The greater part of the duty with the telegraph was by no means local—they scattered messages all over the kingdom. In spite of municipalisation they had the trunk line difficulty which Mr. Boot had spoken of, and he did not see how they were going to get over that. Mr. Boot had mentioned the automatic system. There was a small exchange being fitted in the municipal buildings at Glasgow as an experiment, and he need hardly say it was at the expense of the company who wished to sell the thing. It certainly promised well. He did not see how it would work with a very large exchange, but for anything up to 100 subscribers, which was all it was used for at present, there was no difficulty about it.

Mr. Wordingham (Manchester) said it was pleasant to agree with Mr. Mountain—he could not often. Mr. Mountain was advocating unreservedly the municipalisation of the telephone, and had given a list of his reasons. He (the speaker) had gone through them and tried to criticise them, and his only criticism was a tick against each—he quite agreed with everything the reader of the paper said. The first thing to consider was, as a question of general policy, in whose hands should the telephone system be. He thought there could be no question that the trunk lines ought to be in the hands of the Government. He was equally strongly of opinion that the local lines should be in the hands of the municipality. It was essential to the success of any telephone system that it should be a monopoly, and a monopoly he certainly thought ought to be in the hands of a public body, not a company. But there were other reasons why the local service should be in the hands of the municipality. The municipality already dealt with the individual ratepayer for various services of necessity, such as water, gas, and electric light, and the ratepayers were in the habit of having municipal officials coming to the premises, and the same officials ought to have to do with the telephone service. It was totally different to the telegraphs, because the whole telegraph system was in the hands of the Government or the authority that worked them. There were very few private telegraph offices—the offices were thrown open to the public, and were not situated in the customers' houses. This was a very strong argument in favour of municipalisation, or rather the local exchanges, being in the hands of the municipality. The same reasons which make it desirable, from a commercial point of view, that electric lighting should be in the hands of municipalities, applied equally to the telephone service, because the municipality was in a better position to supply a cheap service, on account of being able to get capital cheaply, and not needing to make a profit, than was a private company. The consideration which would naturally have greatest weight with the councillors was: "Can a municipal telephone service be made to pay?" They were gradually becoming convinced that electric lighting could; but in many cases they very much held back from telephony. He thought it must be granted that a municipality could at any rate put down the system as cheaply as, or more cheaply than, a company, because it was practically certain that any system which was put down now would be put underground. Certainly a system could be put down more cheaply underground by a municipality than by a company. Again, it was notorious that the capital of the National Telephone Company was enormously inflated or watered, but yet they could pay a very handsome dividend. Surely a municipality starting afresh with no past history in the matter could pay very much better than any other old company, and he had tried to show that they could pay better than a new company. He had not the slightest doubt that a municipality could make a telephone system pay exceedingly well. The question of the delay on the trunk lines, which were in the hands of the Government, had been raised. That complaint, unless there was bad attention, which was unlikely, must arise from the fewness of the trunk lines. That again depended upon the number of calls wanted on the trunk lines. If they increased the number of subscribers they would get a larger number of calls, therefore it would pay to put down more lines. That difficulty, he thought, would disappear if the local exchanges system came in. He did not think the Government, for the reasons he had stated, should have the local exchanges, and something pointing to that had been mentioned by Mr. Boot, wherever the Government had established an exchange in competition with even so bad a service as that provided by the National Telephone Company, the Government exchange had always notoriously failed. He might be permitted to make a few remarks on the subject of telephony generally. Those whose experience had been confined solely to electric lighting were apt to rush into the question with preconceived notions, which were altogether at variance with the facts. Those who had been in contact with the practical work knew that, contrary to electric light undertakings, as the scale of operations increased so did the expenses. It was much more expensive to provide an exchange for 10,000 subscribers than 1,000, and the difficulties of working were enormously increased. Practically, the only satisfactory system was the multiple board system, which implied that every consumer should be within the control of one or three operators. They could not make the operator's arms grow to an unlimited extent. There was a reaching area, as it was called, and if they could not get it within this they were driven away from the multiple board principle. Many speakers talked as if the one thing was to get numerous subscribers. Up to a certain point numerous subscribers were desirable, but when they passed a certain number it practically rendered the telephone useless, because there were so many calls that they could not get through to them. There seemed to be a maximum number of consumers which made for a maximum of usefulness—exceed that and it became unworkable. It was not an unmixed benefit to have too many subscribers. Mr. Mountain argued as if the small consumers, so to speak, should be encouraged. Certainly in one sense they should, but if there were very few calls and they used the telephone very little they were occupying space on the multiple boards which was more or less waste, and it occurred to him if the system were extended it might be worth while to group together those subscribers in the exchange who were small users and put them on a separate board to themselves, because, probably, if they called up very seldom the delay of a few seconds in getting through would not matter. As to the method of charging advocated by

Mr. Mountain, to his mind it was certainly a case in which the compound principle should be applied, that was to say, there should be a fixed charge per subscriber to represent the capital cost of his lines and instruments and his portion of the switchboard plus a charge depending upon the number of calls he made. Probably in the case of the present telephone company, it would pay better if the extra charge were based not upon the number of calls, but upon the number of "swear words."

Mr. Longbottom (Huddersfield) said they had taken a great interest in pushing this matter forward at Huddersfield. They were one of the very early towns to endeavour to get this brought to a final issue, and, in fact, they authorised their town clerk at one time to apply to Parliament for powers to work their own telephone. They had proof that they could do it cheaper by the telephones that they used in connection with the Corporation, at about one-third the cost. They were using them at the present time at a little over £3 a year each station. Then, again, the system Mr. Mountain had suggested as to payment according to the messages they sent was something on the principle of the penny-in-the-slot gas meters, which was becoming very popular in Huddersfield. He had no doubt a system of that kind would be just as popular with the telephone. He hoped to live to see the day, although he was getting on in years, when the telephone would be so popular in the different cities and towns in England that every washerwoman would be able to take her orders from clients by that means. He did not see why they should not be able to work the telephone as cheaply as they did on the Continent. Mr. Mountain had given them statistics as to the different towns and cities on the Continent, showing how cheaply it could be done. It spoke badly for Englishmen, who professed to be so very clever in engineering and all these matters, that they should be left so far behind on the question of the telephone. He had no doubt Mr. Mountain was on the right line, and that they would soon see this an accomplished fact in the English towns, and that we should not be in the background as we had been.

Mr. Sidney F. Walker (Cardiff) said he took it that the municipality would only provide a telephone service cheaper than the Post Office; the Post Office service was always good, but very expensive. He could look back 25 years, and the rule had been they had to pay per annum for the Post Office service what they could buy the instrument for. There was none of that healthy competition which existed between municipalities, and which, he thought, had been by far the most favourable symptom in connection with the electric light industry. The Government official had nothing in front of him to gain except extra work; naturally as a human being he did not want any more work than he could possibly help. In the second place, it appeared that the municipality would study local needs much more than a Government official could. They had the same thing there. A Government official would not want to increase his work, that was natural. He would not as a matter of course know the requirements of the district; he could not possibly know them like councillors knew them. Then there was the important consideration—the control of the streets. There should be no question as at the present of the local electrical engineer—the municipal electrical engineer—going hat in hand to a Post Office official with a plan. It should be the other way about. The Post Office official once within the municipal boundary should be subject to the municipal authorities. What he would venture to prophesy would happen would be in each town of any size they would have the electrical engineer, not merely of the telephone or electric light, but he would know the whole science of the thing, and he would have subordinates responsible for the different branches—one for telephone, one for light, one for tramway and for power service, and he would be able, not by a very difficult calculation, to say where the cables should be put, and to this engineer the Post Office official should be obliged to submit. That would give a proper telephone service, and would get rid of a great many of the difficulties that at present existed. There would be no case of the gas man coming along and pulling up the streets and putting them down, then the water man, and next the electric light people, and the telephone men afterwards. All that should be under one control. With regard to Mr. Mountain's estimate, he certainly questioned it. It did not do to hold out rash estimates at first; people were apt to lose confidence in them, and they then could not go on afterwards. Mr. Mountain had a telephone exchange with 6,000 subscribers, and he hoped to put them on for £20 a piece, using underground wires. He (Mr. Walker) ventured to say Mr. Mountain would not do it for that. He (Mr. Walker) put it at three times that amount. He spoke with 20 years' experience of telephone work. He should like to endorse what had been said about the number of calls. Mr. Mountain had considerably under-estimated them. The possible number of combinations followed a parabolic law. Take the two cases which Mr. Mountain had given—the one with 600 subscribers and the other with 6,000. The possible calls for the 6,000 was 100 times the possible calls for the 600. There was this to be taken into consideration, that as the number of subscribers went up, the probable number of combinations they wanted to make would go down. They had to bear in mind another factor rapidly coming to the front—everybody was doing business by telephone. Letters and telegrams went to the wall. It was essential everyone should use it. There was no doubt business men were doing business entirely by telephone. Let them go into the Docks at Cardiff, and they would find three or four telephones humming away all day long. The working cost went up very rapidly indeed, and that was a matter which would have to be faced. If he were laying out an exchange he should not want 6,000 subscribers. He would sooner have 300 or 400 to start with. If they got over a certain number, each additional one became a nuisance. It necessitated connection with the rest; it was a possible additional call, and they found it was a serious matter. The statistics of this thing were very obscure. The actual calls in different exchanges, and from different people were not made known. He would suggest that statistics bearing on this should be obtained. There was no doubt statistics could be obtained from all these foreign telephonic exchanges, and also from English telephonic exchanges and American, and they should be got out in that way. There would be a constant for almost every kind of subscriber. The business man would have a big constant; the washerwoman a small one; the doctor a special constant, and the tradesman a special one. If they had these statistics and other information before them, the municipality could lay down a good system, with the Government taking the trunk lines.

Mr. Mountain, at the close of the discussion, replied. He said local control was the only thing that could make the telephone succeed. Both Mr. Chamen and Mr. Boot referred to the purchase clause. He had no doubt, had they had time to read the paper, they would have read the Treasury minute, which was perfectly clear, and covered the whole point. Any exchange the municipal authority put down must be put down under the supervision of the Post Office. Therefore they could not go far wrong. The Post Office would guide their action to an extent. He thought that would be an immense advantage. He entirely agreed that trunk lines should remain with the Government. He did not think they wanted to bother with the communication between the towns; that would lead to difficulty. He was glad to find Mr. Wordingham agrees with him. Mr. Wordingham had suggested a cure for the immense number of subscribers' difficulty to which he alluded. Mr. Walker also touched on that point. There was not the slightest doubt that as the subscribers increased the capital cost increased. Exchange expenses did not increase in the same proportion. Mr. Wordingham said it would be quite easy to put the residential subscribers together. He showed the difficulty and also the cure. Mr. Walker spoke of 6,000 subscribers being a large exchange. In England it probably was, although the exchange at Manchester was for 10,000. Stockholm, he thought, was for 10,000, and it was, on the Continent, not unusual to find large exchanges.

CENTRAL ELECTRIC SUPPLY COMPANY BILL.

Lord Brougham presided on Thursday last week over a Select Committee of the House of Lords to consider the scheme of the Central Electric Supply Company for power to construct large works for the generation and supply of electrical energy in bulk. Mr. Pember, Q.C., Mr. Balfour Browne, Q.C., Mr. R. Wallace, Q.C., and Lord Robert Cecil, Q.C., were for the promoters; Mr. Worsley Taylor, Q.C., and Mr. Du Cane for the London County Council; Mr. Fitzgerald, Q.C., and Mr. Moon for the Metropolitan Electric Lighting Company, and Mr. Freeman, Q.C., and Mr. Talbot for the St. Marylebone Vestry.

Mr. Pember, Q.C, in opening the case for the promoters, said the Bill was practically for the purpose of making a generating station on the site in the parish of Marylebone on the North Bank Road. There they proposed to erect a generating station for the supply of electricity in bulk. They also sought powers by Section 20 to break up streets. The clause had been carefully elaborated, and they had done their best to meet all proper and natural requirements of those who were in charge of the streets. The intention was to supply electricity in bulk to undertakers who might require to take it in bulk and redistribute it to the public. The bodies so scheduled were the St. James's and Pall Mall Electric Light Company, the Westminster Electric Supply Corporation, the Metropolitan Electric Supply Company, the London Electric Supply Company, the Vestry of St. Pancras, and the Vestry and parish of St. John, Hampstead. The Bill was promoted in one sense by the St. James's and Westminster Companies, who had combined to form a company called the Central Electric Company, but he did not conceal for a moment the large interest which the St. James's and Westminster Companies had indirectly in the promotion of the Bill. The powers of those two companies to supply were being fast overtaken, and they must go further afield for means of supply. They could not endlessly put up generating stations in such neighbourhoods as those they supplied, for, do what they could, there must be some annoyance. Economy was also a serious matter, both for the company and the public. It was a very great object to cheapen electric light and energy, and they had chosen a site, and proposed to carry on the production of energy, under circumstances which would first of all make their energy as cheap as possible for the sake of the public and themselves, and also where their operations could be conducted where they could hurt nobody. The site was in a part of London, the importance of which, from a residential point of view, could not be compared to St. James's or Westminster. The petitioners who appeared against the Bill were the London County Council, the Metropolitan Electric Supply Company, and the Vestry of St. Marylebone. With respect to the London County Council, they had no lighting authority whatever in the districts where they proposed to supply energy to undertakers who had got rights there. Then they said the station would be a nuisance, but no owners or occupiers appeared against the Bill. The main objection of the London County Council was that the companies concerned might abandon their stations in their parishes, and that when the date arrived at which the local authorities would have power to purchase the undertakings, they would be at the mercy of the company as regarded getting a supply of electricity in bulk. He did not see why it needed the London County Council to come and say that on behalf of the local authorities, who could say it for themselves. If the companies did abandon their stations, it would only be because it was better for them to do

so, and if it was better for the company, it would be better for the purchasing authority that they should get a supply from a central station. But the County Council asked that they should be empowered to purchase the undertaking authorised by the Bill at the end of 42 years, although the Joint Committee which considered this matter said such a thing was not practicable. The Vestry of St. Marylebone objected to the creation of a central station of such magnitude in the parish, as it would be a serious nuisance and would depreciate the value of the parish. However, he had no doubt the station would be rated. They also objected to the streets being broken up, but that meant only the laying of a few trunk mains. The Metropolitan Electric Company submitted that the real object of the promoters was to obtain powers to injure them by competition, but that was absolutely untrue. Any attempt of the promoters to do so would be *ultra vires*.

Mr. C. J. Balfour, chairman of the St. James's and Pall Mall Electric Lighting Company and chairman of the Central Electric Supply Company, was then called and gave details of the mean supply from the St. James's Company stations within the parish. With regard to the central station, he thought the two promoting companies might do with one main for the central station, but if other companies wanted a supply in bulk a main would have to be laid to their transforming station. As, however, they could only supply six companies at the most, there could be no more than six mains in the whole district radiating from the centre.

Mr. A. Boulnois, M.P., a director of the Westminster Electric Supply Company and the Central Electric Supply Company, said the Westminster Company, after long and careful inquiry, found it impossible to get a site for another station in Westminster, and were obliged to go further afield. It was absolutely necessary now in order to comply with their statutory obligations that there should be a fresh generating station. He knew Marylebone pretty well and he did not think the Bill would in any way damage the parish.

Professor Kennedy, chief engineer to the Westminster Electric Supply Corporation, said the number of lamps supplied by his company had been steadily increasing. They were adding lamps at the rate of 4,000 a month. They were at the end of their capacity at Davies Street, and the station at Eccleston Place would only run them for about two years more.

Mr. Sydney Dobson, chief engineer of the St. James's Company, said that their output was steadily increasing, and Carnaby Street station could not carry them on longer than three years.

Sir Frede. Bramwell was called to speak as to the proposed site for the central station, and said there was an advantage in cheapness, looking at it in the commercial aspect, and also in the avoidance of nuisance to the people surrounding the works.

Mr. Worsley Taylor, Q.C., then addressed the Committee for the London County Council, and contended that the two companies concerned ought to have come to Parliament in their own names, and not by means of a third company, for those powers. The new company would not be bound by any of the provisions which Parliament had required to be inserted in the provisional orders of these companies, and revision of prices would be rendered impossible.

The Committee then adjourned.

The Committee resumed their consideration of the Bill on Friday, when Mr. Fitzgerald, Q.C., addressed them on behalf of the Metropolitan Electric Supply Company, and asked that the promoters should be restricted to supplying electricity in bulk to the St. James's and Westminster Companies only.

Mr. Freeman, Q.C., also addressed the Committee for the Vestry of St. Marylebone. The Vestry objected to power being given to open streets, because they found from experience that while the expense of such operations was supposed to be borne by the companies, yet it always entailed expense to the ratepayers in the end. They also objected to any power being given to supply within the parish of Marylebone, as they considered it would complicate matters when the time came for the Vestry to purchase the existing undertaking within its boundaries.

Mr. Balfour Browne, Q.C., in replying for the promoters of the Bill, after dealing with the opposition of the Marylebone Vestry, said that the whole object of the Metropolitan Electric Supply Company in opposing the Bill was to protect themselves in their monopoly. The usual clauses would be inserted in the Bill for the protection of that company's mains, and every question there might be in dispute would go to arbitration. The company was now very nearly at the end of its tether, so far as increasing its supply was concerned, and it became absolutely necessary that they should have further generating plant where they could work cheaply, and it was because of that that they had decided to go to the Regent's Canal. Dealing with the question of price, the learned counsel said it would be useless for Parliament to put a clause in the Bill regulating the price at which they should supply, because they were unable to sell to the public generally—they could only supply bodies having Parliamentary powers, whose prices were regulated. The London County Council said that there ought to be a purchase clause inserted in the Bill, but that matter had been decided over and over again against the County Council. In conclusion, Mr. Browne said he was willing to insert words in the Bill by which the company would bind themselves only to supply electricity to authorities or bodies authorised by Act of Parliament, provisional order, or license to supply electricity.

The Committee having conferred in private, the Chairman said the Committee had decided to pass the preamble of the Bill on certain conditions. They desired that the Electric Lighting Acts of 1882 and 1888 should be incorporated, and they had decided that there should be only a single line of route and one single trench for the conveyance of the current to the parishes of Westminster and St. James's. The size of the trench, and the route to be taken was to be agreed upon by the company and the local authority of Marylebone, and in case of a difference of opinion, should be decided by the Board of Trade. In schedule two they had decided to strike out the last four companies. They also desired that the companies should be bound by all the provisions which Parliament had required to be inserted in electric lighting provisional orders. The effect of the Committee's decision is that the Central Company can only supply to the St. James's and Westminster Companies.

On Monday the Select Committee sat to adjust the clauses in view of the terms laid down by them on Friday. A clause was inserted providing that the company should not be entitled, except with the consent of the local authority of the parish of St. Marylebone, to open more than one trench with such bifurcation as might be necessary to connect with the station of the St. James's and Westminster Electric Lighting Companies. A further clause carrying out the condition of the Committee that the supply in bulk for the proposed central station should be limited to the two companies concerned in the promotion was also added. The Bill was ordered to be reported to the House.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

12,183. "Improvements in cut-outs for electrical purposes." T. Taylor. Dated June 12th. (*Complete.*)

12,249. "Improvements in telephone systems and in apparatus therefor." A. T. M. Thomson and P. Warnford-Davis. Dated June 12th.

12,279. "Improvements in electric telegraphs for ships and other purposes." Eversheds & Vignoles, Limited, and S. Eversheds. Dated June 13th.

12,294. "Improvements in and connected with magneto generators." H. Oppenheimer. (Actiengesellschaft Mix & Genest, Germany.) Dated June 13th.

12,297. "Improved means for controlling electric motors, the invention being particularly adapted to the motors of elevators." Otis Elevator Company, Limited. (Otis Bros. & Co. (Incoporated), United States.) Dated June 13th. (*Complete.*)

12,309. "Improvements in storage batteries and methods of preparing electrodes therefor." P. A. Newton. (The Knickerbocker Trust Company, United States.) Dated June 13th. (*Complete.*)

12,315. "Improvements in cord grips for electric light fittings." A. P. Lundberg and G. C. Lundberg. Dated June 13th.

12,350. "Improvements in or relating to electric railways." O. H. Baldwin and I. E. Winslow. Dated June 13th.

12,353. "Improvements in or relating to conduits for electric conductors." F. Jones and F. A. Pocklington. Dated June 13th.

12,393. "Improvements in clockwork mechanism for automatically controlling and operating electrical switches, gas, water, steam valves, or other similar devices at any predetermined hour or hours." H. T. Crewe. Dated June 14th.

12,417. "Improvements in supports for conductors for electric railways." W. R. Wynne. Dated June 14th.

12,419. "Improvements in or relating to electrically-driven sheep shearing and like apparatus." J. G. Packe and F. E. B. Joynson. Dated June 14th.

12,420. "Improvements in wireless telegraphy." F. Braun. Dated June 14th.

12,473. "The electric newspaper." W. T. Cunningham. Dated June 15th.

12,478. "Improvements in electrical accumulators or secondary batteries." O. Behrend. Dated June 15th.

12,490. "Improvements in and relating to electrical pendulum contacts for the operation of time-measuring pendulums." A. G. Brookes. (L. Sell, Germany.) Dated June 15th. (*Complete.*)

12,493. "An improved insulating material for electrical purposes." M. Lachman. Dated June 15th.

12,506. "Improvements in, and relating to, automatic magnetic circuit-breakers." H. H. Lake. (W. M. Scott, United States.) Dated June 15th.

12,535. "An improved filament for incandescent electric lamps." L. B. Patrouilleau. Dated June 15th.

12,542. "An improved cap for electric glow lamps and the like." J. I. Bolton. Dated June 16th.

12,559. "Improvements in, and relating to, appliances for straightening electric battery plates and the like." A. Haig and J. Edgar. Dated June 16th.

12,565. "Improvements in connection with the windings of dynamo machines and induction motors for enabling two rotary phase current pressures to be obtained therefrom." C. D. Abel. (V. Karmin, Austria-Hungary.) Dated June 16th.

12,566. "Improvements in the arrangements and connections of the windings of dynamo machines for effecting the halving of the continuous current pressure, and for obtaining the star centre of the rotary phase current pressure when continuous current and rotary phase current are to be taken off simultaneously." C. D. Abel. (V. Karmin, Austria-Hungary.) Dated June 16th.

12,582. "Improvements in, and relating to, electro-magnetic measuring and indicating or registering instruments." P. E. Weiss. Dated June 16th.

12,627. "Improved manufacture of electric battery plates." E. Andreas. Dated June 16th.

12,635. "Electric meter." E. S. Halsey. Dated June 17th. (*Complete.*)

12,668. "Improvements in earthed coverings or electrical tubular conductors." J. Y. Johnson. (Hartmann & Braun, Germany.) Dated June 17th.

12,685. "An X ray metroscope." E. W. H. Shenton and A. E. Dean. Dated June 17th.

12,696. "Improvements in telephones." E. Wilson and C. J. Evans. Dated June 17th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

4,824. "Improvements in rail bonds for electric railways." F. H. Daniels. Dated February 23rd, 1887. Relates to rail bonds. A flexible body portion is inserted into end pieces, which are then heated, compressed, &c., to bring them into the form desired with the ends and body integral. 4 claims.

10,062. "Improvements in electric bells and the like." J. G. Dixon. Dated April 22nd, 1897. The bell is adapted to be used either as a trembling or single stroke bell. A magnet is placed in a case, with the cores projecting through one side to operate the hammer on the spring armature. The case and terminal cover are filled with paraffin wax, &c., to render the arrangement water-tight, and a cover screwed on to the case. A hammer guard is provided. Wires are connected with a water-tight push and a contact breaker. The latter is of the usual type, but by turning a pivoted arm the contact breaker may be included in or excluded from the circuit. The circuit includes only the magnet coils, so that on completing the circuit both the main and auxiliary armatures are attracted and held, giving a single stroke, but by turning the arm on to the terminal, the contact breaker is included, and the bell acts as a trembling bell. The push, which is formed on the lid of the case, has a water-tight flexible cover, depressing which completes the circuit through a spring. A gong may be provided for the auxiliary armature and hammer.

10,086. "Electric hair drier." H. Fütterer. Dated April 22nd, 1897. A plate or casing contains a thin insulated conductor adapted to be heated by an electric current. The appliance may be plain, or may be provided with teeth, attached or removable, and the teeth may be perforated to keep the points cool. 3 claims.

10,444. "Improvements in portable electric batteries." R. R. Moffat. Dated April 27th, 1897. Rotary sealed battery combined with an electric incandescent lamp, and adapted for use as a miner's and velocipede lamp, and as a portable lamp in general. The battery comprises two cells, each in two parts, united by a screw ring. The plates or electrodes are situated in the upper part of the cell, and the electrolyte in the lower part, so that the battery is set in action by turning it upside down on a pin connected to the socket by which the lamp is fixed on a bicycle, or elsewhere. The lamp is mounted on a bracket fixed to the rings. Between the connections to the lamp is fixed a resistance piece, which can be short circuited when required. 7 claims.

12,028. "Improvements in carbon plates for galvanic batteries." R. W. Atkinson and S. F. Walker. Dated May 15th, 1897. Carbon plates for use in batteries are saturated with sulphur. This is effected by first saturating them in vacuo or otherwise with a liquid volatile at the temperature of molten sulphur, such as chloride of carbon, water, or preferably chloride of sulphur, which volatilises and replaces the liquid. The adherent sulphur is removed after the plates have cooled. When copper or other metal is to be deposited locally on the carbon, the desired portion is first immersed as an anode in an electrolyte, such as copper sulphate, to remove the sulphur, the copper, &c, being then deposited in the usual manner. 2 claims.

12,029. "An improved apparatus for maintaining a constant temperature of metallic wires heated by an electric current." R. Bergland and Baron R. de Wendel. Dated May 14th, 1897. Relates to a device for maintaining a constant temperature in a metallic wire by an electric current from a primary battery. The heating current flows through a fine resistance wire, and, should the temperature rise above the allowable limit, the wire elongates so far as to allow the completion of a circuit by a pivoted lever and an adjustable contact piece, thereby energising an electro-magnet, which latter pulls over an armature and breaks the primary circuit. When the wires have regained their normal temperature the circuit is automatically made by the release of the armature. Slightly modified arrangements are described. 1 claim.

12,443. "Improvements in electric accumulators." A. Werner and P. de Kilduchevsky. Dated May 19th, 1897. The negative plates or electrodes are formed of thin sheets of galvanised iron or of other metal covered with an alloy formed of zinc, magnesium, and cadmium, which is deposited thereon from a solution of the sulphates of these metals during charging, and is re-dissolved during the discharge. The alloy may also be deposited upon thin grids of metal filled with a paste of lead, zinc, and cadmium in the spongy metallic form. The zinc may be replaced by a metal of the iron group. In the provisional specification the alloy with which the plates is covered is stated to be either of zinc and magnesium or of cadmium and magnesium. 3 claims.

20,914. "Improvements in coin-freed electricity meters." F. C. Raphael. Dated September 11th, 1897. From a shaft rotating at a uniform rate a parallel shaft is driven at speeds depending on the particular pairs of wheels thereon which are brought into gear by the action of a solenoid, E, in shifting it in opposition to a spring or weights. Thus sooner or later a cam on the driven shaft closes the gap between a pair of separating terminals and on electro-magnetic switch cuts the main circuit. The initial position of the cam relative to the terminals is determined by a coin-freed attachment for turning the shaft by hand. 6 claims.

20,943. "Improvements in the construction of guards or protectors for incandescent electric lamps and other glass or breakable articles." J. Dickson and H. E. Brown. Dated September 11th, 1897. Electric incandescent lamps, globes, chimneys and mantles for gas lamps and other brittle articles are protected while in use or in transit by guards, made of coiled plain, twisted or plaited wires. These may be pressed flat when not in use. The guard is coiled at one end to fit on the cap and at the other to hold a short rubber tube or elastic packing and the point of the bulb. Two or more coils may be connected by strips or wires. 2 claims.

21,054. "Improvements in and relating to surface contact electric railway systems, electric cars and their equipment, and automatic switches for use therewith." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States). Dated September 14th, 1897. Electric railways on a road contract system with electro-magnetic switches operated from a battery on the vehicle. When the vehicle is reversed, as by means of a Y-track, the connection of the brushes, which rub over the high and low potential studs, have to be changed and also the connections of the battery which operate the switches. Auxiliary shoes for this purpose rub over an extra earthed contact so as to excite one or other of the coils to throw the double pole reversing switch to make the connections as desired. Several modifications are described with various dispositions of extra shoes and contacts to supply current to this switch. The storage battery is charged from the line circuit, and the ordinary resistances on the car are used to reduce the potential of the current used. The driver's controller is therefore arranged so that at starting the battery is in series with the motors and in multiple with some of the resistances, and, on increasing the speed, the battery is cut out. To maintain the circuit on the vehicle for lighting when the motor is cut out, extra contact connections are provided on the controller, so that the battery current can flow to the switch in the road to maintain the line circuit. A switch is provided to cut out this part when the circuit need not be maintained, which also allows current to be supplied for a longer time by changing the resistance connections. 15 claims.

21,100. "Improvements in alternating electric current generators." W. R. Lake. (H. Fairbanks, United States.) Dated September 14th, 1897. Relates to the class of dynamos known as inductor alternators, in which the generating coils are wound on stationary iron cores, through which the magnetic flux is directed by masses of iron moved across the ends of the cores. According to the present invention a continuously magnetised field is employed, and each pole is divided into two or more pole divisions, which are wound alternately with right and left handed generating coils, connected so as to form a single circuit. The pole divisions and inductor teeth are so spaced that, in one position all the right-handed divisions are bridged by the inductor teeth, while in the next position all the left-handed divisions are so bridged, thus producing a rapid variation of the magnetic flux, and consequently an alternating current in the generating coils. Each of the field poles is divided into two projections, which are wound alternately in opposite directions, connected so as to form a single circuit. The field magnet is excited by a winding, and alternating currents are produced in the circuit by rotating a laminated inductor furnished with three teeth. Two series of overlapping coils are wound alternately through a number of grooves formed by sub-dividing the two field poles. The field magnet is excited by the current derived from a few coils wound on the inductor, through a commutator and brushes. The principle of the invention may be extended to multipolar and to polyphase machines. A form of machine is described in which the poles of the field magnet consist of two parallel discs furnished with laminated projections, wound with two series of generating coils, between which rotates an inductor, consisting either of an iron disc with projecting teeth, or of a non-magnetic disc carrying masses of iron. 6 claims.

21,119. "An improved reflector for electric incandescent lamps." J. Houbois. Dated September 14th, 1897. Relates to holders for incandescent lamps. Hollow glass reflectors are secured between the parts of adapters, which carry ordinary capped lamps and are placed in ordinary holders. Bayonet or screw joints may be used, with spring plungers or central contacts. 1 claim.

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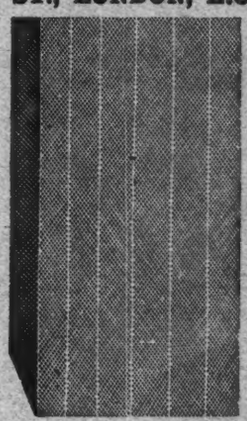

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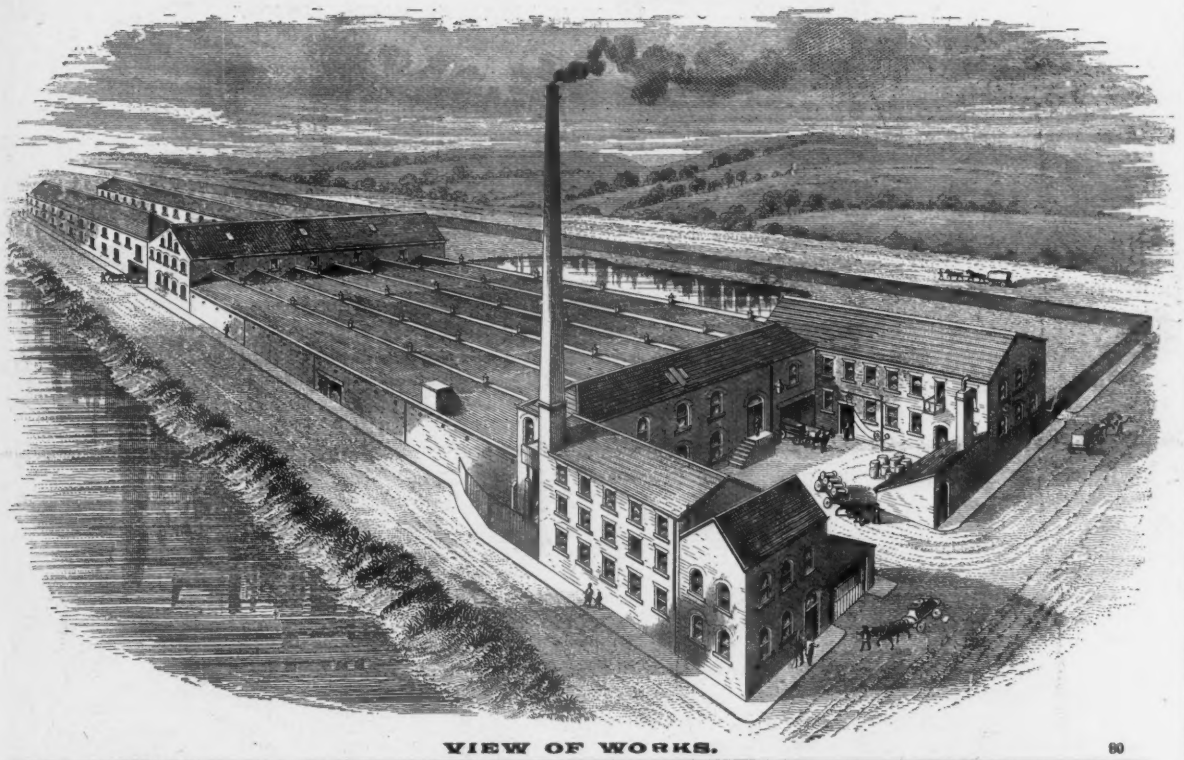

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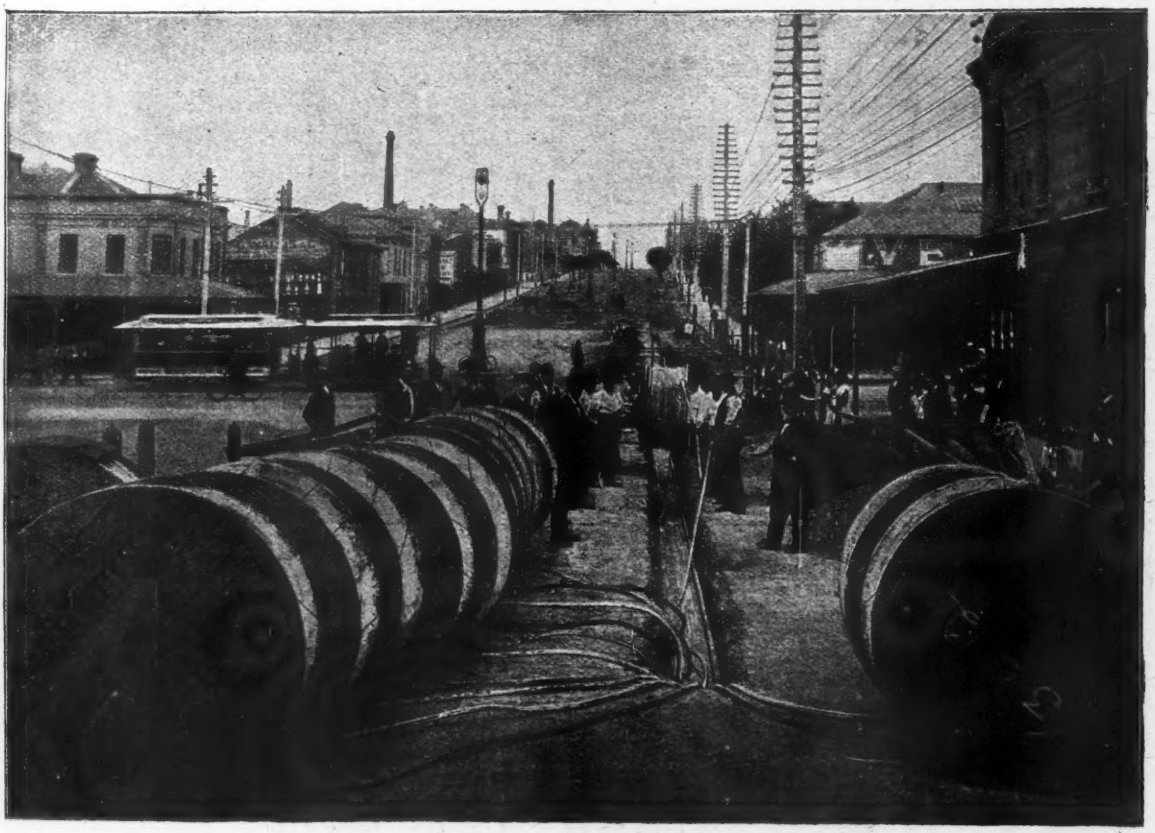

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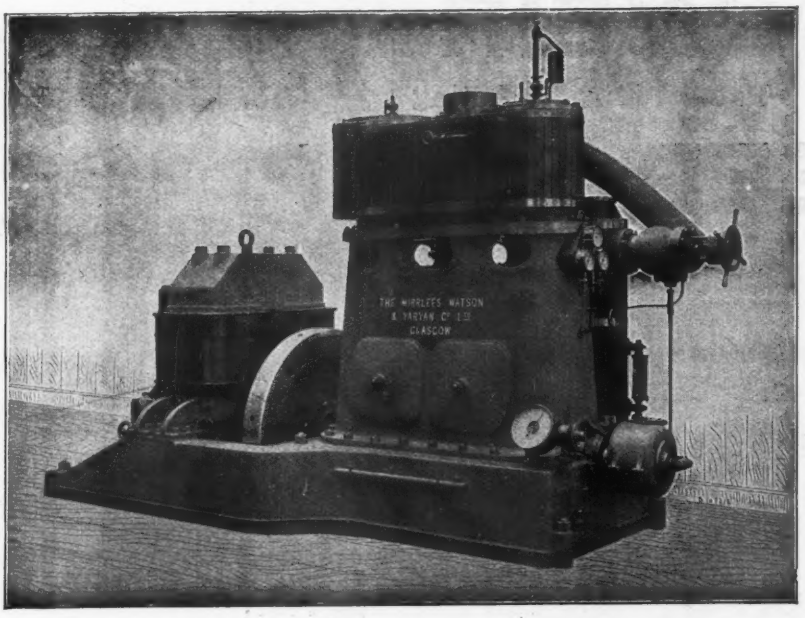

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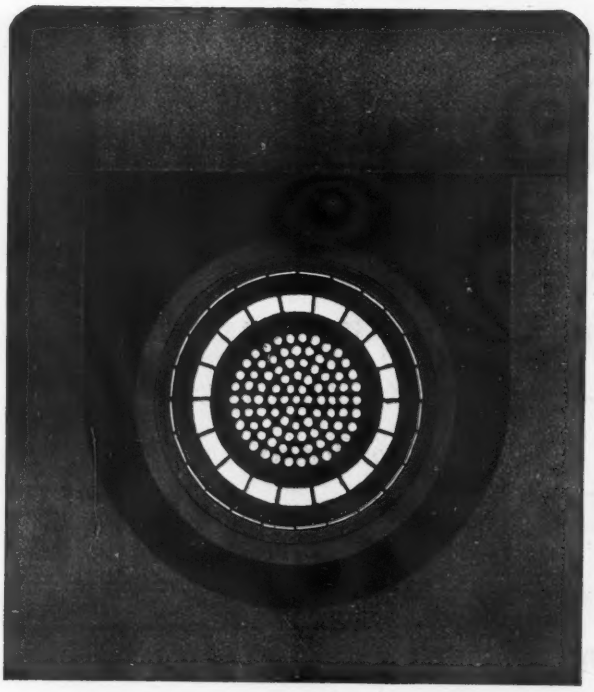

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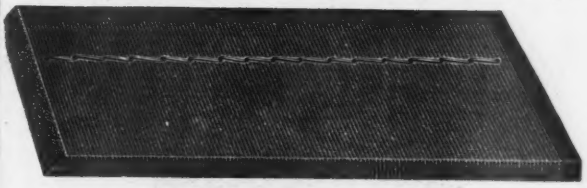

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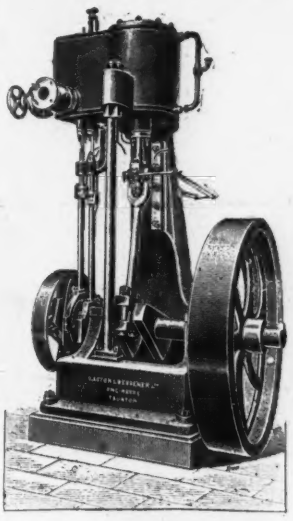

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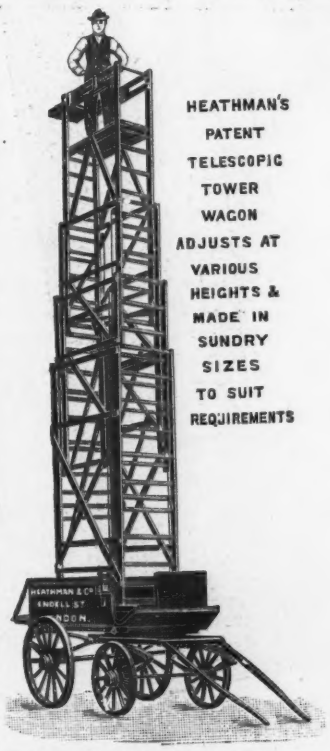

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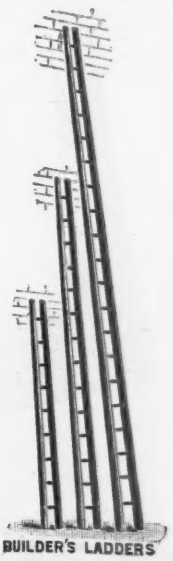

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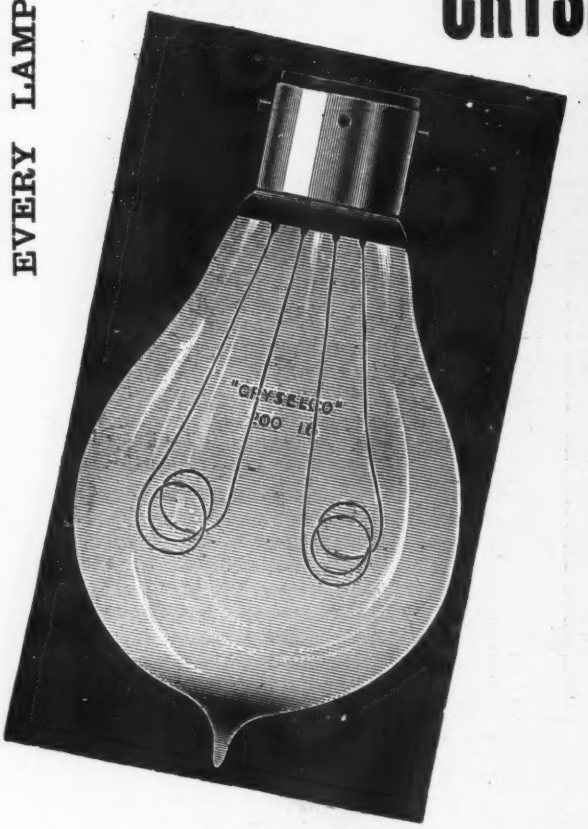

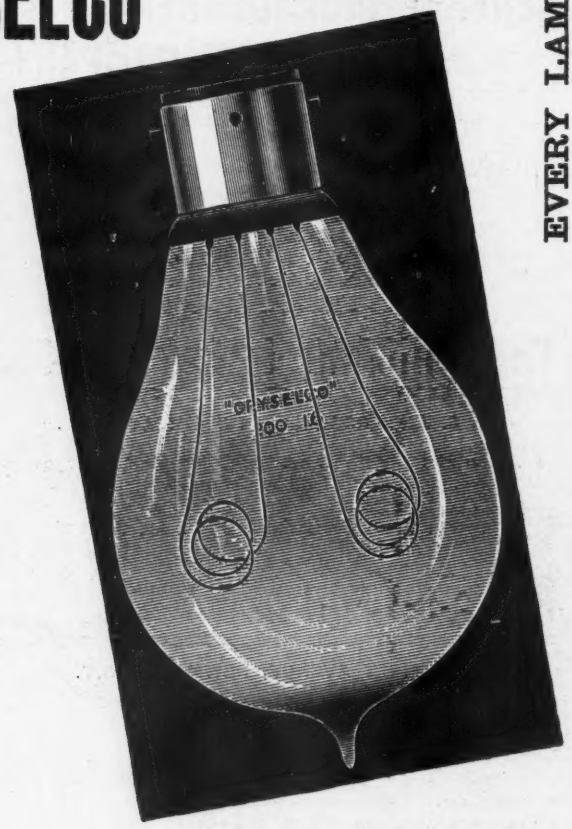

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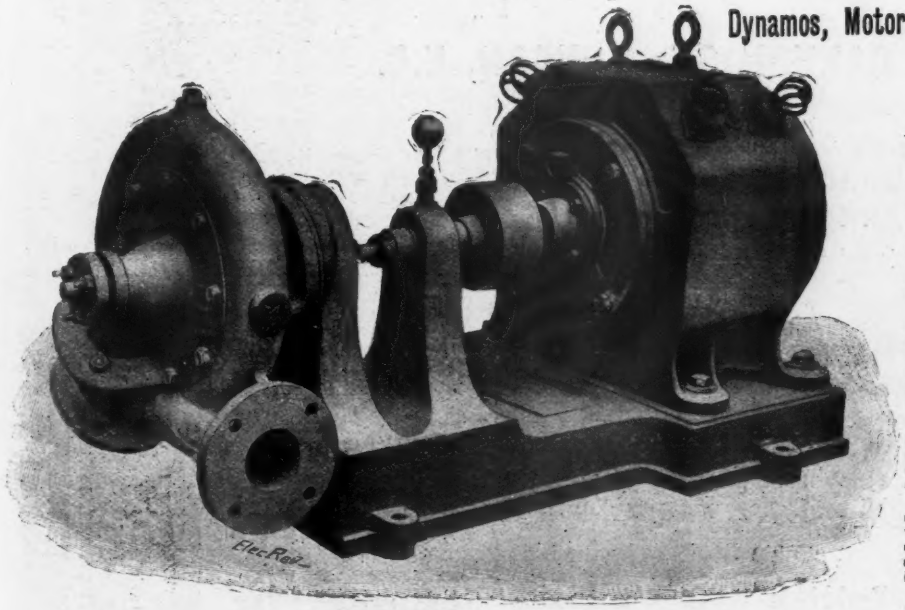

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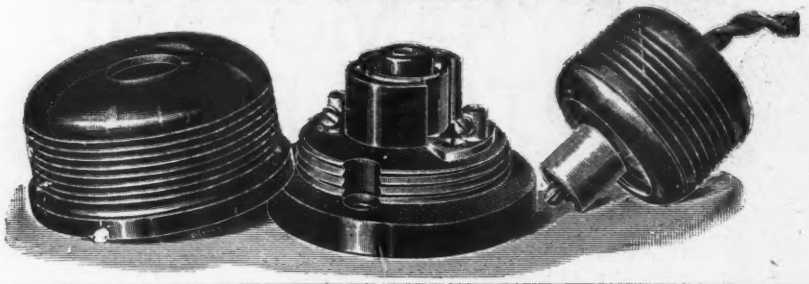

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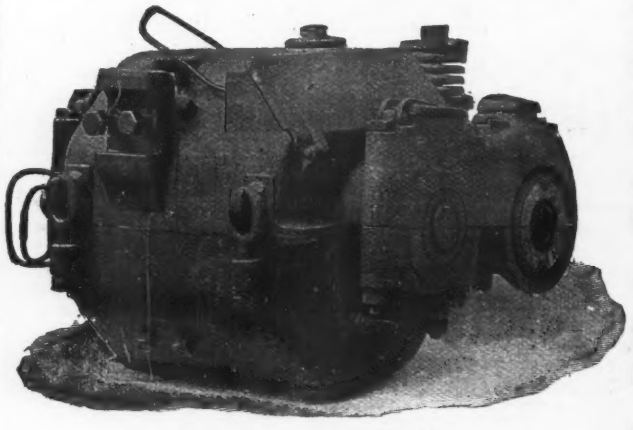

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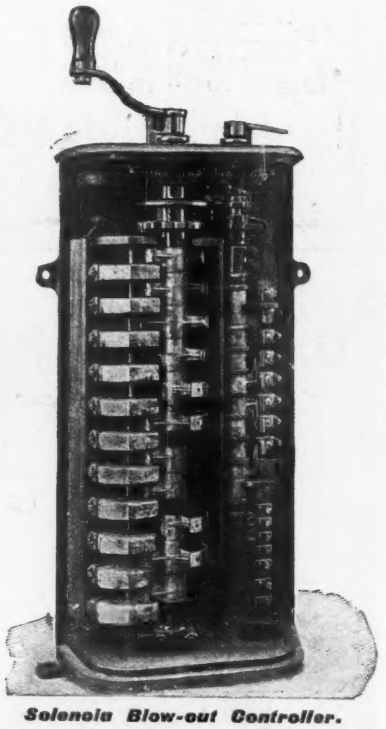

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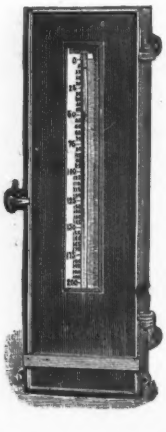

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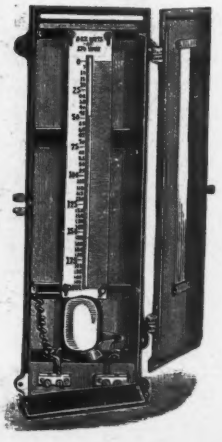

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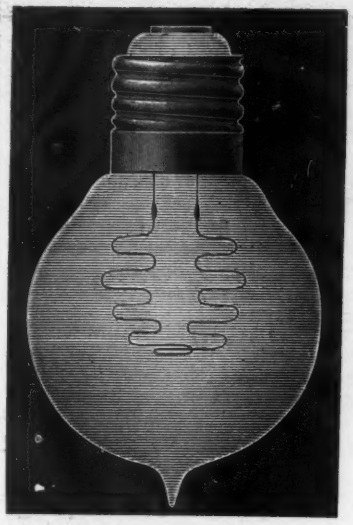

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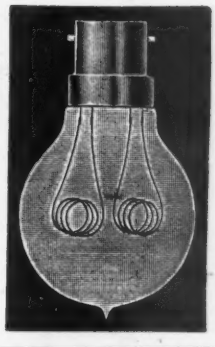

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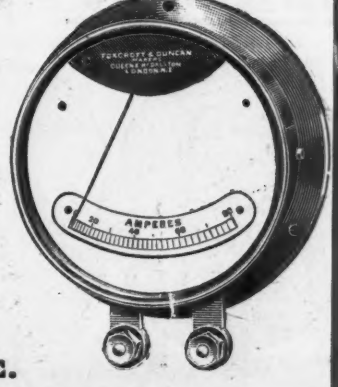

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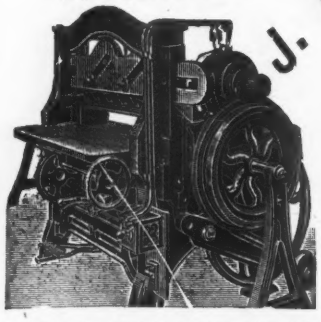

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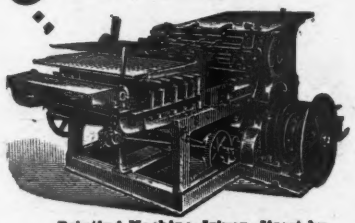

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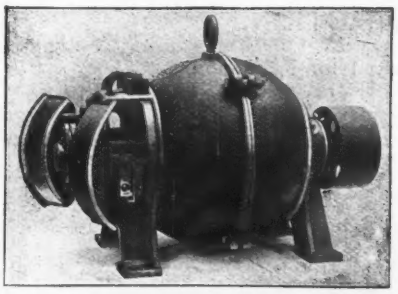

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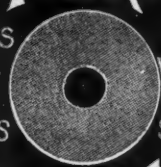

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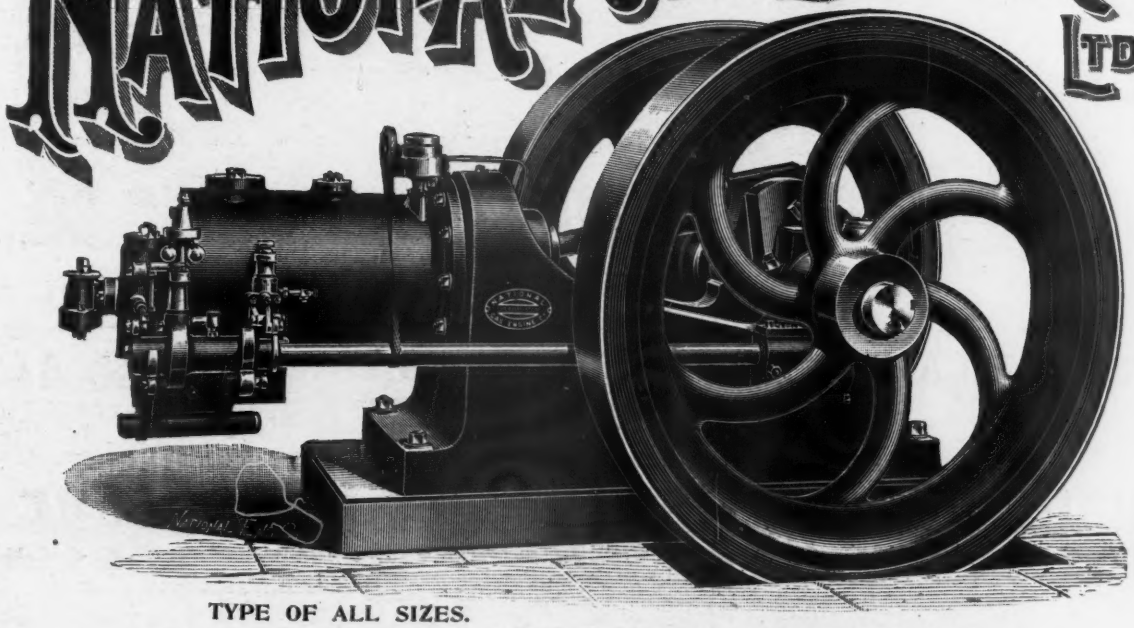

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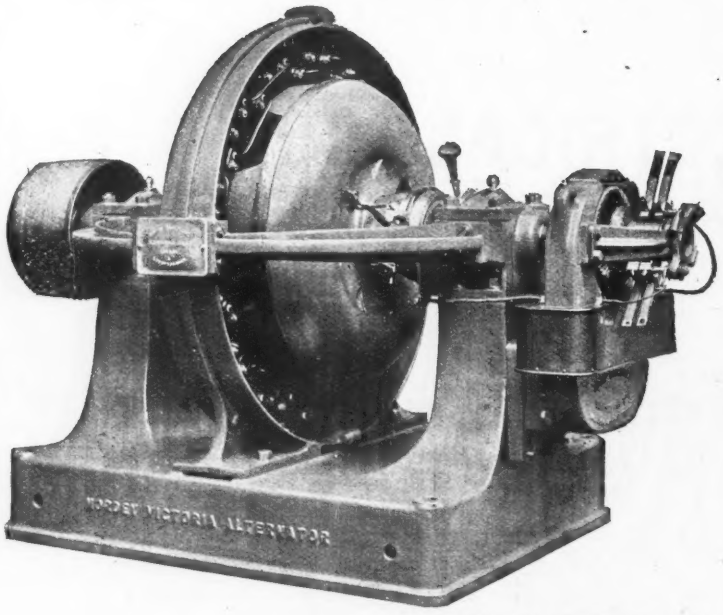

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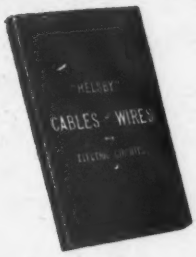

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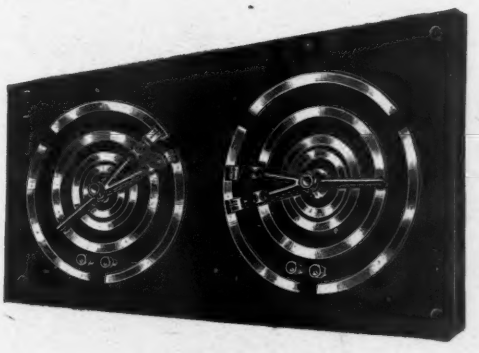

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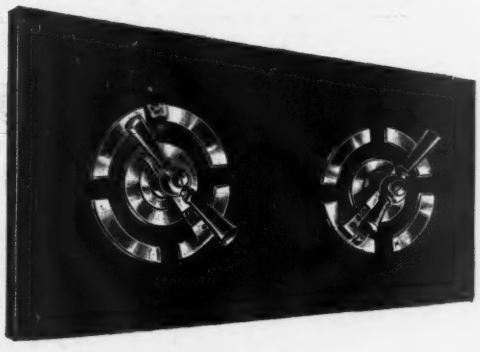

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For full particulars of the above regulator—Heath and Field's Patent—Consult the A Section of our Catalogue. We manufacture the Regulators in any capacity from 100 to 1000 amperes, and arranged to produce 16, 25, 30 or 36 steps.

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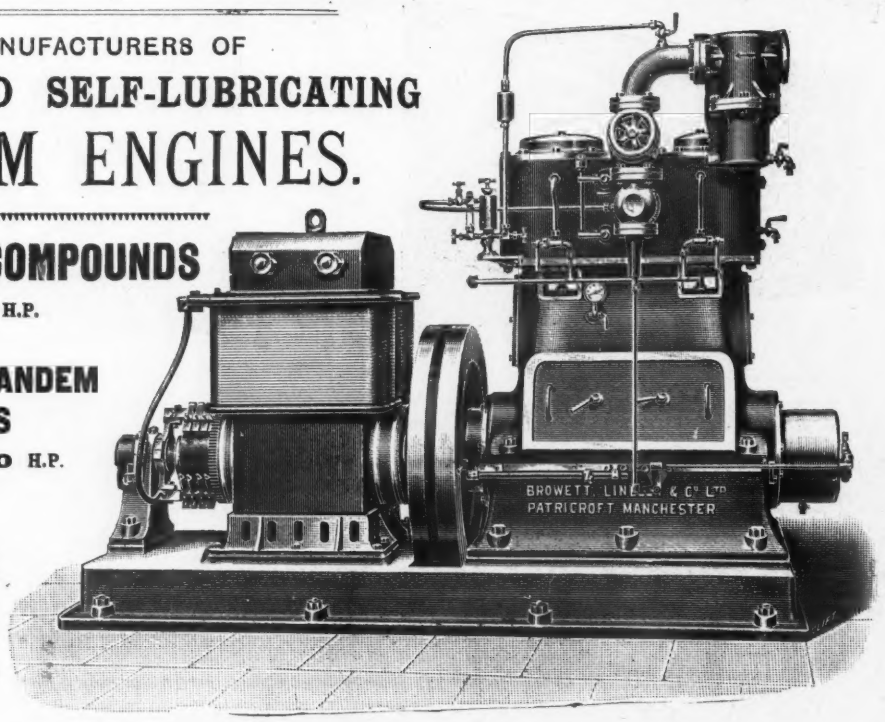

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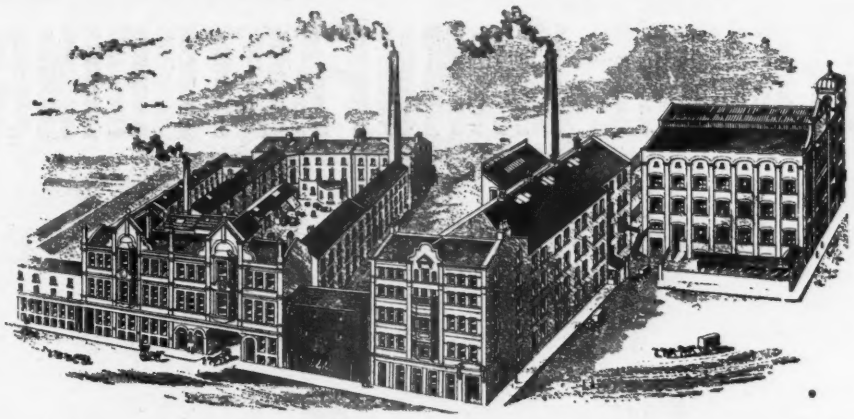

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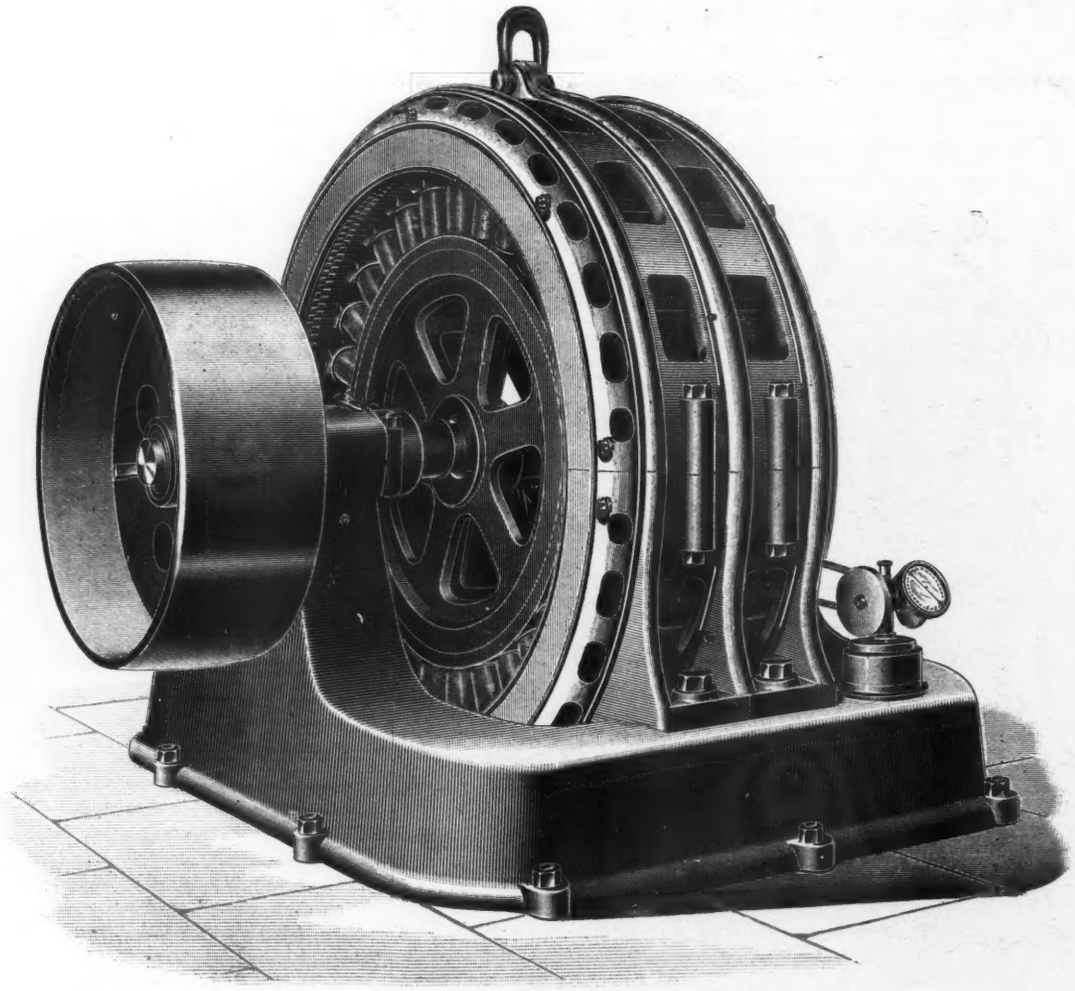

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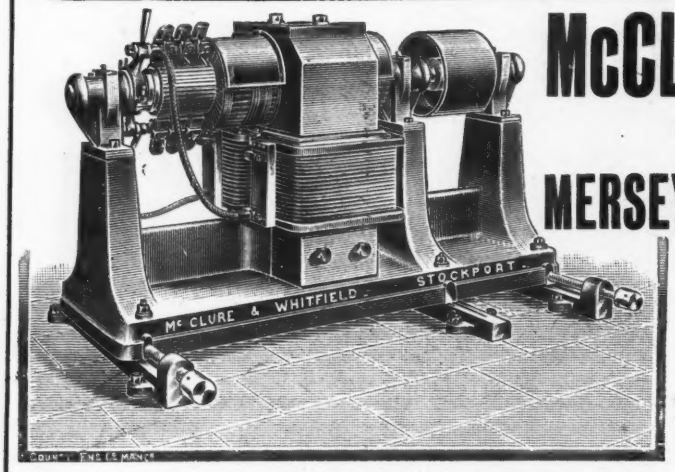

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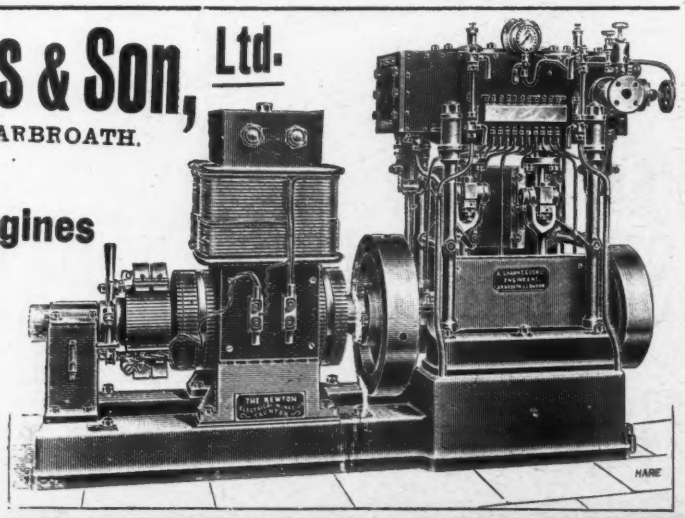

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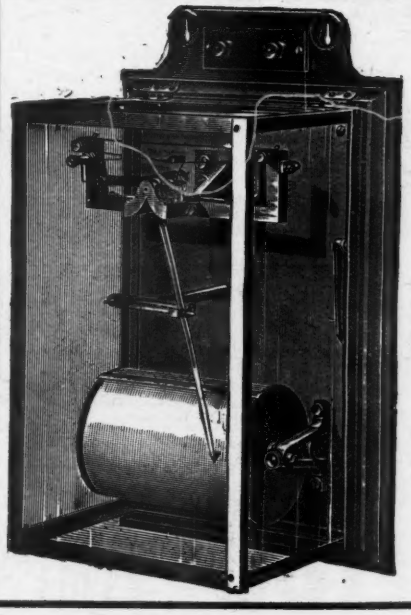

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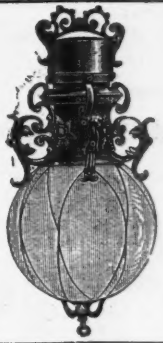

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JOHN WATNEY, *Hon. Secretary,*
City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C. 5343

Official Notices.

COUNTY BOROUGH OF SOUTH SHIELDS.

ELECTRIC LIGHTING.

THE CORPORATION OF SOUTH SHIELDS invite Tenders for the supply and erection of the following plant :—
Arc Lamps and Lamp Posts.

Copies of Specification, including Conditions of Tender and Form of Tender, can now be obtained at the Borough Electrical Engineer's Office, West Holborn, on payment of One Guinea, which sum will be returned on receipt of a *bonâ fide* tender.

Tenders sealed and marked "Tender for Street Lighting Plant," to be delivered to me by 10 o'clock on JULY 10th, 1899.

The Corporation do not bind themselves to accept the lowest or any tender.

By Order,
J. MOORE HAYTON,
Town Clerk.

Court Buildings, South Shields,
June 28th, 1899. 5760

Official Notices.

WALLASEY URBAN DISTRICT COUNCIL.

ELECTRIC SUPPLY.

To Electrical Engineers, and others.

THE WALLASEY URBAN DISTRICT COUNCIL are prepared to receive Tenders for the supply and erection of a 300 Kilowatt Alternator with Engine Combined.

Copies of the Specification may be obtained on application to the Engineer, Mr. J. H. Crowther, at his office, Great Float, near Birkenhead. A charge of £2 2s. will be made for each copy of the Specification, to be returned on receipt of a *bonâ fide* tender.

Sealed Tenders, on the form provided for the purpose, addressed to the undersigned, and endorsed "Tender for Engine and Alternator," to be delivered, per post, at my office, as under, not later than THURSDAY, JULY 20th, 1899.

The contractor will be required to enter into a bond with approved sureties for the due performance of the contract.

The Council do not bind themselves to accept the lowest or any tender.

By Order,
H. W. COOK,
Clerk to the Council.

Public Offices,
Egremont, Cheshire,
June 21st, 1899. 5707

WALLASEY URBAN DISTRICT COUNCIL.

ELECTRIC SUPPLY.

TO ELECTRICAL ENGINEERS AND OTHERS.

THE WALLASEY URBAN DISTRICT COUNCIL are prepared to receive Tenders for the supply and delivery of Alternating Current Transformers.

Copies of the Specification may be obtained on application to the Engineer, Mr. J. H. Crowther, at his office, Great Float, near Birkenhead. A charge of £1 1s. will be made for each copy of the Specification, to be returned on receipt of a *bonâ fide* tender.

Sealed Tenders, on the form provided for the purpose, addressed to the undersigned, and endorsed "Tender for Transformers," to be delivered, per post, at my office as under, not later than THURSDAY, JULY 20th, 1899.

The contractor will be required to enter into a bond with approved sureties for the due performance of the contract.

The Council do not bind themselves to accept the lowest or any tender.

By Order,
H. W. COOK,
Clerk to the Council.

Public Offices,
Egremont, Cheshire,
June 21st, 1899. 5708

GLASGOW CORPORATION TRAMWAYS.

ELECTRIC TRACTION.

THE CORPORATION OF GLASGOW are prepared to receive Tenders for the Supply and Erection of the undernoted :—

Division 1.—Boilers.
,, 2.—Steam Engines (Main and Auxiliary).
,, 3.—Three-Phase Generators, Continuous Current Generators, Rotary Convertors, Boosters, and Static Transformers.
,, 4.—Surface Condensers, Feed Pumps, Circulating Pumps, and Air Pumps.

Specifications, with Forms of Tender, for any or all of the above items or divisions can be obtained on application to Mr. John Young, General Manager, 88, Renfield Street, Glasgow.

A bank draft for Five Guineas, payable to John Young, General Manager, must be sent along with application for Specifications and Forms of Tender for each of the divisions 1, 2 and 3, and for division 4 Three Guineas. The deposits will be returned on receipt of a *bonâ fide* tender.

Sealed Tenders, marked "Tender for ——," to be lodged with Sir J. D. Marwick, Town Clerk, City Chambers, Glasgow, not later than SATURDAY, JULY 22nd, 1899.

The Corporation do not bind themselves to accept the lowest or any tender.

J. D. MARWICK,
Town Clerk.

City Chambers, Glasgow,
June 16th, 1899. 5690

BINKO, RIDSDALE & CO., LIMITED.

In Liquidation.

FOR SALE by tender, in one lot, the stock-in-trade consisting of electrical fittings, switches, holders, bells and pushes, cable, indicator and bell cases, spark coils and accessories, together with the machinery and fixtures at 120, Minories.

The whole can be viewed on the premises between 10 a.m. and 4 p.m., Saturdays up to 2 o'clock.

Tenders to be sent to Mr. W. B. PEAT, Liquidator, 3, Lothbury, London, E.C., by 2 o'clock on the 12th July, 1899. The liquidator does not bind himself to accept the highest or any tender. 5755

[*Continued on next page.*]

Official Notices.—*Continued.*

BOROUGH OF NELSON.

THE GAS AND ELECTRICITY COMMITTEE invite Tenders for the supply of an Engine and Dynamo (output from 25 to 50 Kilowatts), either new or secondhand. Further particulars can be obtained from Mr. W. Foster, Gas Manager, Nelson.

Tenders, endorsed "Engine and Dynamo," giving full particulars and price of the machine, to be sent to me, the undersigned, not later than JULY 5th.

R. M. PRESCOTT,
Town Clerk.

Town Clerk's Office,
Town Hall, Nelson,
June 20th, 1899. 5699

EDINBURGH CORPORATION.

ELECTRIC LIGHTING.

THE LORD PROVOST, MAGISTRATES AND COUNCIL are prepared to receive Tenders for installing the Electric Light at the Central Fire Station, Laureston.

The Specification, Form of Tender, and Plans of the Building, can be obtained at the Office of the Resident Electrical Engineer, 5, Dewar Place, Edinburgh, on or after Tuesday, July 4th, on deposit of Two Guineas, which deposit will be returned on receipt of a *bona fide* tender.

Tenders must reach me not later than TUESDAY, JULY 18th.

THOMAS HUNTER, W.S.,
Town Clerk.

City Chambers, Edinburgh,
June 27th, 1899. 5748

COUNTY BOROUGH OF SALFORD.

TO TRAM CAR BUILDERS.

TENDERS are invited for a Sample Tram Car. A copy of the Plans and Specification, and a Form of Tender may be obtained at the Borough Engineer's Office, Town Hall, Salford. A deposit of One Guinea will be required, which will be returned on receipt of a *bonâ fide* tender.

Tenders, endorsed "Sample Tram Car," and addressed to the Chairman of the Tramways Committee must be delivered to me not later than 4 p.m. on TUESDAY, JULY 18th, 1899.

L. C. EVANS,
Town Clerk
(Pro tem).

Town Hall, Salford,
June 27th, 1899. 5760

COUNTY BOROUGH OF HALIFAX.

THE CORPORATION OF HALIFAX are prepared to receive Tenders for the supply, delivery and fixing of a Combined Steam Engine and Dynamo.

The Specification and Form of Tender can be obtained on application to the undersigned, on payment of a deposit of Three Guineas, which will be returned on receipt of a *bonâ fide* tender.

The Corporation do not bind themselves to accept the lowest or any tender.

Sealed and endorsed tenders are to be sent into me not later than JULY 15th, 1899.

H. F. STREET.

Borough Electrical Engineer's Office,
Foundry Street, Halifax. 5761

THE ELECTRICAL DEVELOPMENT AND FINANCE CORPORATION, Ltd.,

39, VICTORIA STREET, WESTMINSTER, S.W.

Telegraphic Address: "UMPOLAR, LONDON."
Telephone No. 419, Westminster.

The objects of the Corporation are the development and financing of approved Electrical and Industrial Undertakings of all kinds. 2348

161, KENNINGTON ROAD, S.E. *161, KENNINGTON ROAD, S.E.*

E. H. CRIPPS,

MAKER OF ALL KINDS OF

SWITCH & FUSE CASES,

BLOCKS & BOARDS OF ALL DESCRIPTIONS,

In Teak, Mahogany, Oak, Walnut, and all Whitewoods, &c.

PRICE LIST OF STANDARD SIZES ON APPLICATION.

ESTIMATES FREE. 5075

LONSDALES, Blackburn,

BOILER COVERERS,

Will send a sample cask (5 cwts., 25/-, carriage paid) of their

PATENT PLASTIC CORK COVERING

Telegrams: "Plastic, Blackburn." *Telephone No. 625.*

London Agent:—G. GREAVES, 38, Raymond Road, Upton Park, E.

G. E. BELLISS & CO., Ltd.,

BIRMINGHAM.

QUICK-REVOLUTION ENGINES

For ELECTRIC LIGHTING, POWER and TRACTION.

See Illustrated Advertisement Alternate Weeks.

THE BRITISH THOMSON-HOUSTON CO., Ltd.,

83, Cannon St., London, E.C.,

ELECTRICAL ENGINEERS AND CONTRACTORS.

SEE LARG ADVERTISEMENT IN LAST WEEK'S ISSUE

THE BOOK OF BOOKS FOR WIREMEN, ELECTRICAL ENGINEERS, CONTRACTORS, CONSTRUCTING ENGINEERS, ARCHITECTS AND STUDENTS.

HOW TO WIRE BUILDINGS

A MANUAL OF THE ART OF INTERIOR WIRING,

By AUGUSTUS NOLL, E.E.

Cloth, 8vo, Illustrated. 162 *Pages. Price, 6s. Post Free.*

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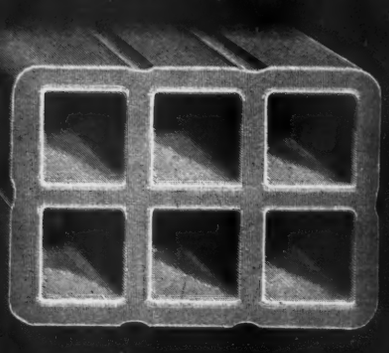
For Underground Cables.

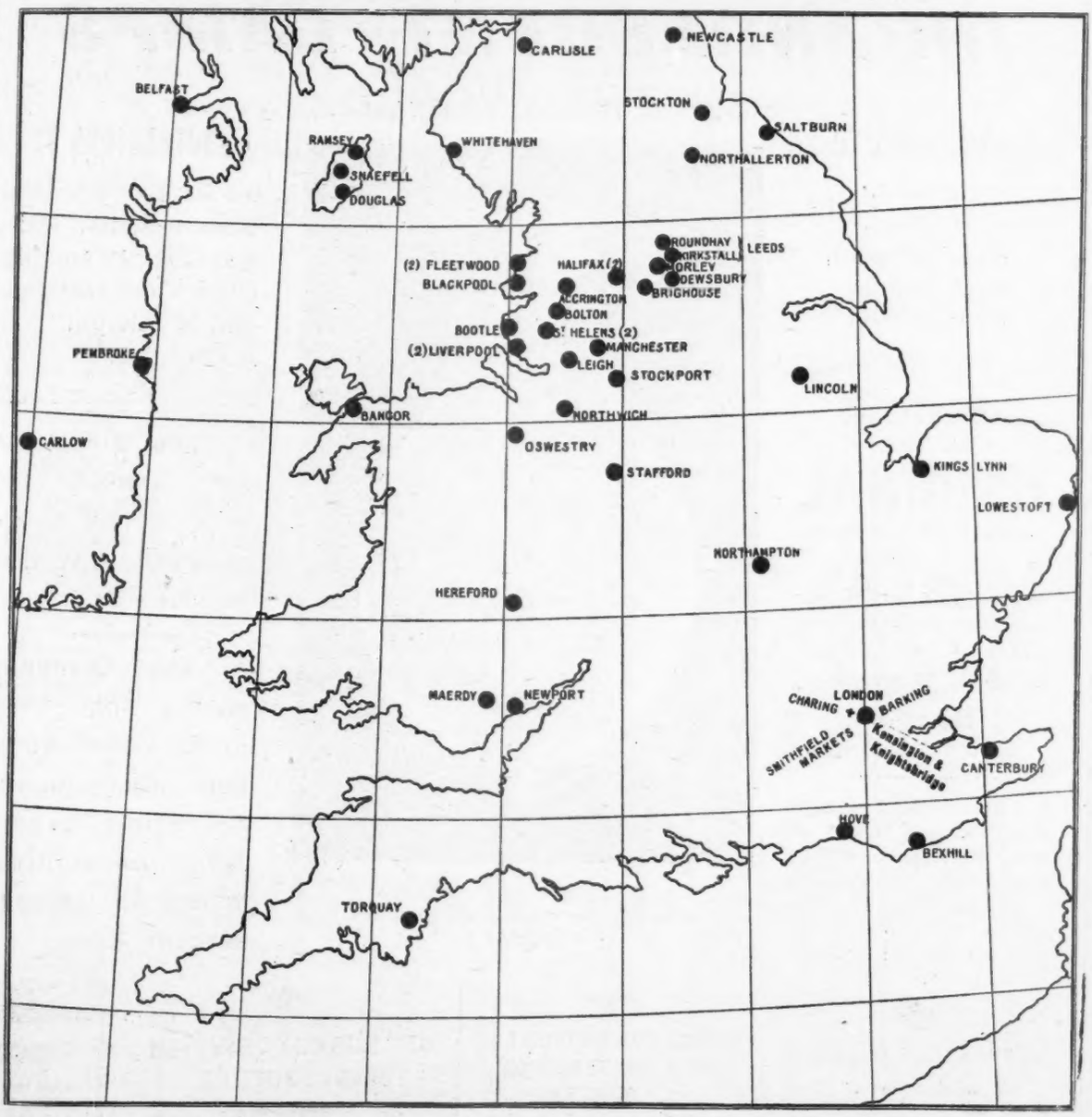


DOULTON & CO., LIMITED,
LAMBETH, LONDON, S.E.

CHLORIDE BATTERIES

ARE UNEQUALLED FOR

ELECTRIC LIGHT AND POWER SUPPLY.



AS OPERATED AT THE **50** STATIONS SHOWN ABOVE.

For Particulars and Prices apply to the

Chloride Electrical Storage Syndicate,

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London Office:
39, VICTORIA STREET, S.W.
Telegrams:—"CHLORIDIC, LONDON."
Nat. Tel.—597, Westminster.

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Telegrams:—"ACCUMULATE," PENDLEBURY.
Nat. Tel.—1,638, Manchester.

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UNITED ELECTRIC LIGHT

Head Office, Showroom and Warehouse: EDISWAN

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LARGEST MANUFACTURERS OF *INCANDESCENT LAMPS* IN THE WORLD.

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MANUFACTURED BY THE ORIGINAL MAKERS

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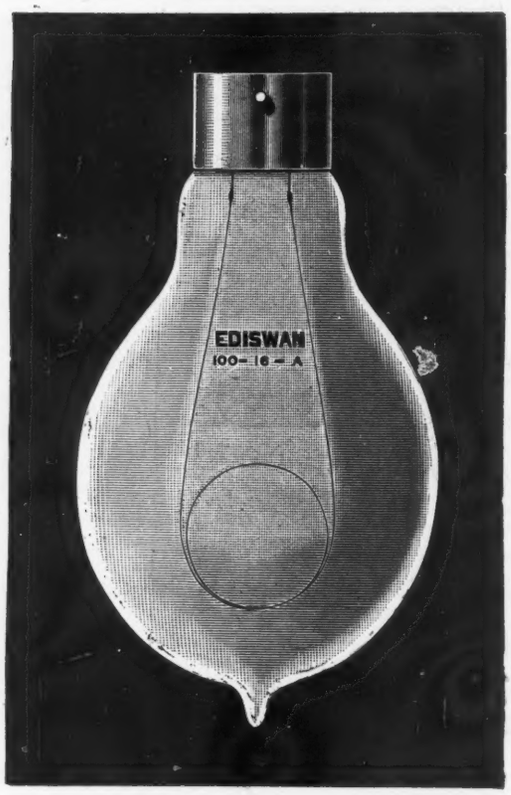
*PONDER'S END.***
**And South Benwell,
Newcastle-on-Tyne.**

All other Lamps which claim to be of first quality are either made in accordance with the Edison or the Swan patents, or in close imitation of these inventions.



Standard Lamp.—Full Size Illustration.
See that every Lamp is stamped with the Trade Mark
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the leading Colonial Governments, Railway Cos., Steamship Cos., Corporations, and Municipal Authorities.

The Bulbs for the Lamps are made at the Company's Glass Works, Ponder's End.

The Company is the only Firm in the United Kingdom wholly manufacturing every thing connected with an Incandescent Lamp

TRADE EDISWAN MARK

ACCURATELY MARKED.

ABSOLUTELY RELIABLE,

Every Lamp being

CAREFULLY TESTED.

NOTED FOR ECONOMY IN THE CONSUMPTION OF CURRENT.

EQUALITY OF LIGHT

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Life of the Lamp.

OF PURELY BRITISH MANUFACTURE.

MADE IN VARIOUS VOLTAGES AND CANDLE POWERS.

PROVINCIAL DEP SALE and

BIRMINGHAM:— International Exch Buildings, Edmu *Telephone No. 997.*

BELFAST:— 134, Royal Avenue. *Telephone No. 649.*

CARDIFF:— Westgate *Telephone No. 771.*

DUBLIN:— 12, Dawso *Telephone No. 635.*

DUNDEE:— 17, Castle *Telephone No. 149.*

GLASGOW:— 153, West George *Telephone No. 4151.*

WORKS:—

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LIVERPOO 11, St. G *Tele*

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Telegram addressed to any *EDISWAN," foll*

BEST & CHEAPEST IN THE END.

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N & SWAN

LIGHT COMPANY, LIMITED.

DISWAN BUILDINGS, QUEEN STREET, LONDON, E.C.

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Patent High-Voltage Tumler Switches.

BLACK OR WHITE PORCELAIN BASES,
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THOROUGHLY RELIABLE,
PERFECT CONTACT,
QUICK MAKE,
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HULL:—1, Grosvenor Buildings, Carr Lane. *Telephone No. 449.*

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LIVERPOOL:—11, St. George's Crescent. *Telephone No. 1406.*

MANCHESTER:—Victoria Bridge, Exchange Station Approach *Telephone No. 582.*

NEWCASTLE-ON-TYNE:—38, Grey Street. *Telephone No. 1035.*

's End, Middlesex;
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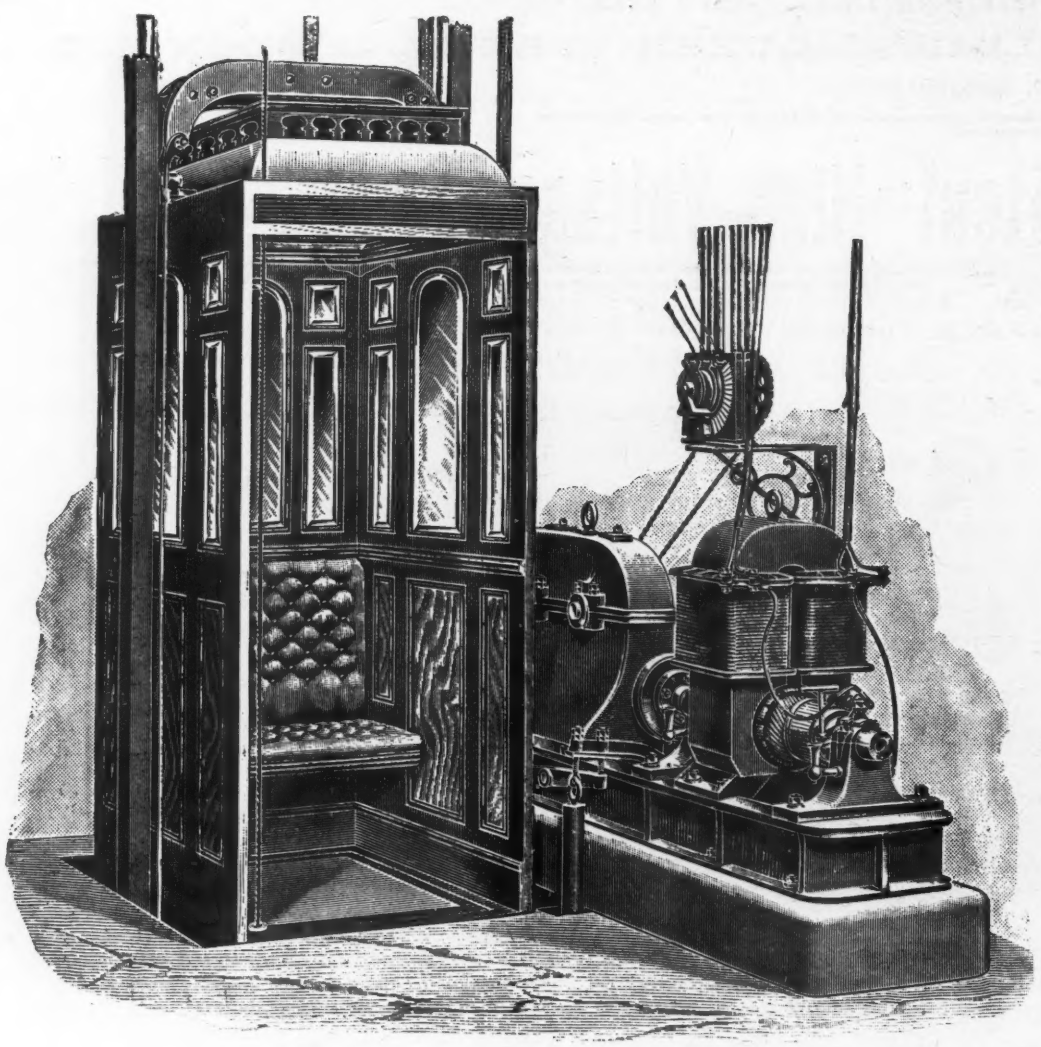
EDISWAN," followed by Name of Town

REVERSIBLE

AUTOMATIC LIFT CONTROLLER.

(PATENT.)



THE SPECIAL ADVANTAGES, OVER THE USUAL MAGNETIC FORM OF CONTROL, ARE AS FOLLOWS:

1. A perfectly accelerated start, free from all jerk.
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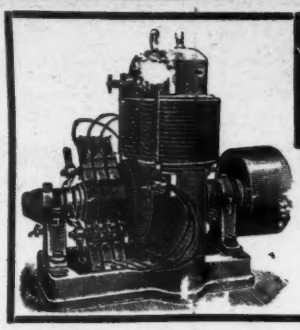

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SLOW SPEED.
HIGH EFFICIENCY.

J. H. HOLMES & CO.,
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DYNAMOS

THE ELECTRICAL REVIEW.

PUBLISHED EVERY FRIDAY, PRICE 4d.
Office: 4, LUDGATE HILL, LONDON.

To be obtained by order from any Newsagent in Town or Country.

NOTICE TO ADVERTISERS.

The following are the LATEST times up to which Advertisements can be received for publication in current week's issue:—

New Advertisements, or Alterations to existing ones, Wednesday 2 p.m
Small Announcements for middle pages, Thursday 2 p.m.

TELEPHONE No. 15,077. Telegram: "INDICES," LONDON.

WHEATLEY KIRK, PRICE & CO.

(ESTABLISHED 1850),

Electrical Auctioneers, Valuers,
AND ARBITRATORS.

Average Annual Valuations exceed £2,000,000 sterling.

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CHEAP PREPAID ADVERTISEMENTS,

Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY *Per Word (minimum 1s.).*

Three consecutive Insertions for the Price for Two.

***** This Scale does not apply to Trade Advertisements, terms for which can be had on application.**

SITUATIONS VACANT.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Original Testimonials should never be sent.

CITY AND COUNTY OF BRISTOL.

IMPROVERS.

THE ELECTRICAL COMMITTEE are prepared to receive applications for the vacancies for two Improvers.

Applications in writing to be sent to the undersigned before Wednesday, July 12th. Only those who have had a thorough theoretical grounding and practical experience in engineering works need apply.

Premium £100, term two years. Salary £50 during second year.

H. FARADAY PROCTOR,
A.M.I.C.E., M.I.E.E.

City Electrical Engineer's Office,
Bristol. 5749

THE MIDDLESEX HOSPITAL CONVALESCENT HOME, CLACTON-ON-SEA.

RESIDENT ENGINEER AND ELECTRICIAN required; must be a married man—wife to have care of lodge. Wages, £80 per annum with residence, coal, lighting, and kitchen garden.

Apply on Monday Morning next, July 3rd, between 10 and 12 a.m., to the SECRETARY, The Middlesex Hospital, Mortimer Street, W., from whom all particulars can be obtained.

June 26th, 1899. 5756

CITY AND GUILDS OF LONDON INSTITUTE, TECHNICAL COLLEGE, FINSBURY.

WANTED (1) JUNIOR DEMONSTRATOR in the Physical Laboratory. Must have had experience in Laboratory instruction and in Tutorial work in Heat and Electricity.

Salary £100 a year, rising by increments to £150.

(2) INSTRUCTOR in Electrical Engineering, having had experience with polyphase and high voltage work. Duties mainly in Laboratory.

Salary £100 per annum.

Applications to be made in the first instance to Prof. SILVANUS P. THOMPSON, F.R.S., Technical College, Finsbury, E.C. 5759

SITUATIONS VACANT.—*Continued.*

COUNTY BOROUGH OF DEVONPORT.

DRAUGHTSMAN.

THE CORPORATION OF DEVONPORT are prepared to receive applications for the appointment of an Architectural Draughtsman in the Borough Electrical Engineer's Office, competent to prepare plans for electricity works buildings to the design of the Borough Electrical Engineer. One having had experience in an engineer's office preferred. Salary £96 per annum.

Canvassing, either directly or indirectly, any member of the Council will absolutely disqualify a candidate.

Sealed applications, endorsed "Draughtsman, Electricity Works Department, stating age and experience, with copies of not more than four recent testimonials (which will not be returned) must be sent to the undersigned on or before July 1st, 1899.

A. B. PILLING,
Town Clerk.

Town Clerk's Office,
Devonport,
June 21st, 1899. 5702

DRAUGHTSMAN required, with experience in switch work preferred.—Apply to "DRAUGHTSMAN," Switch and Rectifier Department, S. Z. de Ferranti, Ltd., Hollinwood, Lancs. 57 6

DRAUGHTSMAN.—Smart junior, switch work, accurate and neat, with good knowledge of mechanical details. State experience, age, and salary. Copies of testimonials.—5762, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5762

DRAUGHTSMAN wanted in London, well up in alternating current work and with workshop experience.—Apply, with full particulars, to Box 5758, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5758

FIRST-CLASS Armature Winders wanted accustomed to heavy slot windings of all sorts. Continuous employment guaranteed to really good men; 9½d. per hour and railway fare paid.—Apply, D. BRUCE PEEBLES & Co., Tay Works, Edinburgh. 5815

THE Lynton and Lynmouth Electric Light Company, Limited, have a vacancy for a Pupil or Improver, small premium; no salary first year. Good opportunity to gain an all-round experience in high tension work.—J. H. Fooks Bale, A.M.I.E.E., Director and Manager, Lynmouth, Devon. 5782

TRAVELLER required for country.—State terms and experience to W. J. M. MENZIES, Esq., General Manager, Consolidated Telephone Company, Coventry. 5731

WANTED at once by a consulting engineer (London) a good general draughtsman for permanency, capable of setting out electric light and power plants, engine rooms, &c., and preparing diagrams of switchboards, &c. Applicants should state age, qualification, previous experience, and salary required.—Address, Box 5741, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5741

WANTED, by large firm of builders and contractors in London, an efficient and practical Electrician capable of preparing specifications and estimates for, and superintending installations of lighting and bells to buildings.—Apply, stating age, experience, and salary required, to Box 5775, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5775

WANTED by the Wireless Telegraph and Signal Company, Limited, Junior Assistants well up in electrical science. Those with a good knowledge of Hertzian work and acquainted with practical telegraphy preferred.—Apply in the first instance, by letter only, to 28, Mark Lane, E.C., stating age, qualifications, and salary expected. 5742

WANTED.—Competent Fitter to superintend electrical repairs in tramcar shed.—"CITY ELECTRICAL ENGINEER," Hull. 5774

WANTED.—First-class Engineering Draughtsman, accustomed to dynamo and motor designing.—Address "DRAUGHTSMAN," W. Porteous & Co., Glasgow. 5808

WORKS manager wanted for small but growing electrical engineering works. Must have a thorough training in mechanical engineering, and be fully conversant with the latest labour-saving tools and methods, and have had experience in the management of men. Should also understand the manufacture of dynamos, motors, and switch gear, and have a good theoretical knowledge of electricity.—Address 5740, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5740

[*Continued on next Page.*]

SITUATIONS WANTED.

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ADVERTISER seeks Situation as Improver at high tension station, with traction if possible, home or abroad. Had good theoretical and practical training; certificated.—5711, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5711

ASSISTANT (Good), used to Simplex.—"F. S.," 101, Darwen Street, Old Kent Road. 5777

ELECTRIC Tram Cars.—Advertiser desires change, 20 years' English and American, shop and office; good references.—Address, 5738, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5738

ELECTRICAL Engineer, of good education and address, will shortly require position of trust, Assistant Manager, supply or contracting business; varied experience in shops and office work.—Apply, 5717, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5717

ELECTRICAL Engineer (24) eight years' experience desires responsible post with contractor, business experience.—Full particulars on application to 5763, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5763

ELECTRICAL Engineer (35) seeks engagement, technical and practical knowledge. Lighting, power, tramway work, planning, estimating, testing and superintending.—Apply "R. F.," 152, Clarence Street, Bolton. 5769

ELECTRICAL Engineer (23), desirous of gaining experience in electric traction work, seeks appointment. Salary no consideration.—Apply, 5736, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5736

ELECTRICAL Engineer, with 10 years' varied practical and theoretical experience in the design, testing, and erecting of dynamos and motors, desires engagement; excellent references.—5716, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5716

ELECTRICIAN (24), large and varied experience in all kinds of installation work, seeks responsible position; highest references.—5710, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5710

ELECTRICIAN, age 30, with good practical experience on installation work, seeks engagement as Working Foreman; good references.—HERBERT, 24, Grosvenor Street, Camberwell. 5649

ELECTRICIAN (25), practical, seeks engagement as Manager or Foreman over installation department. Varied experience in wiring, estimating, and superintending; home or abroad.—Apply, 5639, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5639

ELECTRICIAN seeks Engagement; 17 years erecting electric light installations, planning, estimating, testing, &c., good mechanical experience, knowledge of French and German; would go abroad.—5683, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5683

ELECTRICIAN wireman requires situation, town or country, own casing, conduit or concentric, plant or bench.—"A.," 6, Princess Street, Northampton. 5747

ENGINEER (28) nine years' varied practical and theoretical experience and training; draughtsman, installation work, automobiles, switchboards.—5751, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5751

GOOD Certificated Wireman wants permanency, West End work preferred; references.—5770, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5770

SHIFT Engineer wants Engagement; three years in charge.—5647, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5347

SWITCHES and Accessories.—Practical Foreman desires re-engagement; thoroughly experienced in every detail of manufacture, good draughtsman, 5½ years in last situation.—F. J. JONES, Highbridge Road, Wylde Green, near Birmingham. 5767

WELL Educated Marine Engineer, first-class certificate, excellent references, aged 31, desires work on station. Prospect of learning sufficient to obtain appointment of more consequence than wages. — Apply, 5655, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5655

WIREMAN, competent, requires work, own casing.—GEORGE, 29, Stock Street, Plaistow. 5778

WIREMAN (Experienced), casing or conduit. — "H. H.," 1, Old Kent Road. 5776

WIREMAN, experienced, wants work; jointing, tubing, casing, or plant work.—5681, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5681

WIREMAN seeks Situation, own casing or iron conduit system. Abstainer; good references.—"S. W.," 54, Kilton Street, Battersea, S.W. 5754

WIREMAN (25) seeks re-engagement; casing tubing; capable take charge.—"W.," 9, Kilburn Square, N.W. 5745

WIREMAN (Young) seeks re-engagement, in London preferred.—Apply, "H.," 9, Hurstbourne Road, Forest Hill. 5752

YOUNG Electrical Engineer, seeks engagement, experienced in wiring, estimating, and electrical machinery construction, able to invest small amount.—Apply, 5737, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5737

YOUNG Man (19) wants job as Wireman's Assistant or Jointer's Mate.—"B.," 5, Beaumont Mansions, West Kensington. 5662

FOR SALE.

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CHEAP PLANT.—Oil Engine (Crossley) 2 flywheels, tank and piping, dynamo and belt, run 50 lamps 16 C.P., voltmeter, 2 Chamberlain-Hookham meters, 2 Crompton-Pochin best quality arc lamps, 16 hour 8 ampere, together or separate; erected if desired. — Apply, 5477, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5477

ELECTRIC Light Plant.—The Committee of the Conservative Club, Glasgow, have for Sale the following plant:—One 50 brake horse-power Otto Gas engine, fitted with two flywheels, electric light governor, starter, water vessels, exhaust piping, &c. One compound wound Taunton dynamo, with an output of 300 amperes 110 volts, at 700 revolutions per minute. Also accumulator, 53 cells, of E.P.S. make, L31 size. The above can be seen at the Conservative Club on application to the Secretary, to whom offers, including removal, should be sent for the whole or part of the above. 5766

ELECTRICAL Business for Sale, thorough good installation and supply business, centrally situated in best shipping town, price about £400. Satisfactory reasons for disposing. Could be greatly extended if required.—Apply, 5765, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5765

FOR SALE.—A set of 54 L-type E.P.S. accumulators, complete with covers, trays and insulators, with five positive and six negative plates; 15 of the cells have one positive plate missing, and 16 of the cells have the plates defective, the remaining 23 cells are in good condition. All the negative plates are good, and there is one spare set of negative plates. The size of the boxes are 6½ × 12 × 13. Shunt wound dynamo, 55 volts 30 amperes, by Rosling & Matthews; compound wound dynamo, 100 volts 16 amperes, same makers, with fly-wheel and three bearings. Goods can all be seen in Birmingham.—Apply 5660, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5660

FOR SALE.—Crompton-Burgin compound-wound dynamo, 80 volts 80 amperes, £30. Ditto, series, 60 volts 15 amperes, spare armature, £22. Crompton double carbon lamps for above, £2 each. Gramme series dynamo, 80 volts 15 amperes, £7 10s. 12,000 good carbons, cored and solid, 11 to 15 m/m; average £1 5s. per 1,000. 2,000 5 to 20 ampere switches, slate bases, laminated contacts, from 40s. per gross.—"ELECTRICIAN," 67, Holly Avenue, Newcastle-on-Tyne. 5764

FOR SALE.—Fitting Shop (small but well equipped), with steam power. In Midlands. Best offer, without reserve.—Apply, 5735, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5735

FOR SALE.—Owing to expiration of partnership, small central station in Midlands, capable of considerable extension.—Write, Box 5739, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5739

FOR Sale or Hire.—High-class Dynamos, Motors, Alternators, Projectors, Cable, and Arc Lamps.—PERCY HUDDLESTON AND Co., 72, Finsbury Pavement, E.C. 5723

SEVERAL ½-H.P. Motors, 100 and 200 volts, £4; with 11" fans, £4 10s.—CUTTING BROS., Derby. 5771

ARTICLES WANTED.

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ELECTRIC Cooking Stove (small) wanted, by W. LINCOLN, Holles Street, Cavendish Square. 5784

PLATINUM in any form and quantity, purchased at highest prices by DERBY & Co., 44, Clerkenwell Road, London. 6522

WANTED, Compound Wound Dynamo, 200 lights, must be in good condition. State price, maker, and where to be seen.—Address, 5772, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5772

WANTED.—Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 5481

WANTED, two new or second-hand Steam Dynamos, 30 and 75 kilowatts respectively; steam pressure 120 lbs.; volts 200 to 220.—DAVY BROTHERS, LIMITED, Sheffield. 5768

MISCELLANEOUS.

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ACCUMULATOR CHARGING.—C. H. Cathcart & Co., having plant specially adapted for this purpose, charge cells of all sizes promptly, thoroughly and cheaply. Terms on application. Accumulators on hire for temporary lighting, experimental uses, &c.—3, Dorset Buildings, Salisbury Square, Fleet Street, E.C. (Telephone No. 65,266). 7865

[*Continued on next Page.*]

MISCELLANEOUS.—*Continued.*

ACCUMULATORS (old), Copper Cable, Scrap Metal, Metal Dust, and Metal Refuse of any kind bought for cash.—Write, A. BROWN, 77, Lansdown Road, Dalston, London. 3678

DYNAMOS and Motors.—Commission offered to Gentleman calling on electrical engineers, by manufacturers of machines up to 12 units. State ground covered and full particulars to 5733, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5733

ELECTRICAL Engineer, A.I.E.E., desires engagement as Assistant or Manager in contracting or consulting work with view to partnership. Small salary required to start.—Apply, 5744, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5744

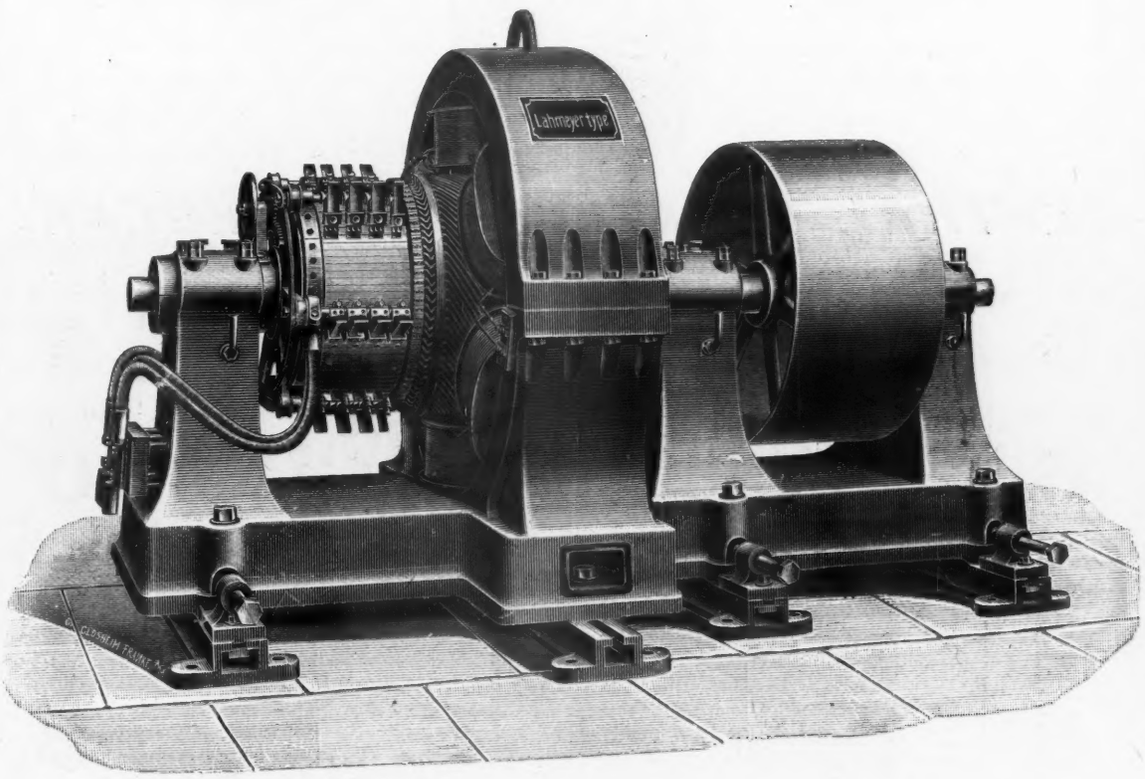
MISCELLANEOUS.—*Continued.*

M.I.E.E., with office in London, is open to represent one or two good firms. Has good connection among general and electrical engineers.—5743, ELECTRICAL REVIEW, 4. Ludgate Hill, London. 5743

MESSRS. Allan & Adamson, Ltd., removing to their new works at Ashtead, Surrey, are prepared to sub-let their present offices and works at 88 and 90, Tabernacle Street, E.C., consisting of five well lighted floors and basement, low rental; gas engine if required. 5718

OPENING for junior working partner, to take charge of recently established branch, fixed salary, £104, share of profits about £200, making £300 to commence, which can be increased yearly. Capital required, £1250.—5753, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 5753

DYNAMOS and MOTORS.



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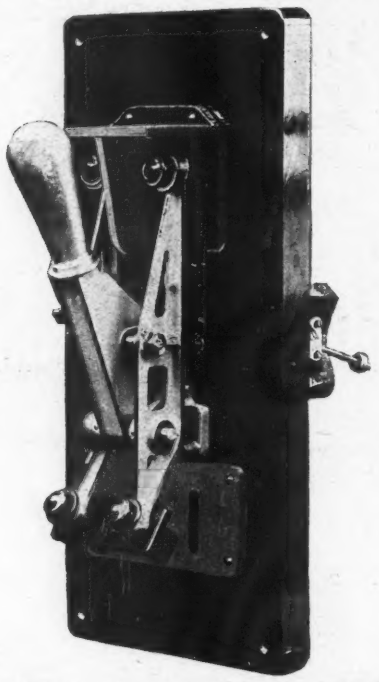

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For Alternating and Continuous Current.

CENTRAL STATION SWITCHGEAR.

Telegrams: "Control, Manchester."

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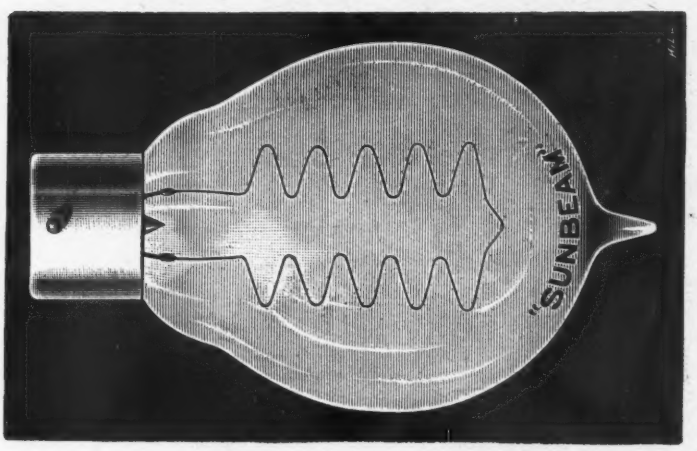
AGENTS IN EVERY PRINCIPAL TOWN.



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"MARQUAND" ACCUMULATORS.

A Planté Plate
but Lighter, Stronger, Cheaper
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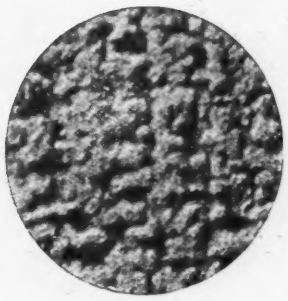

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THE MARQUAND ACCUMULATOR Co., Ld.,
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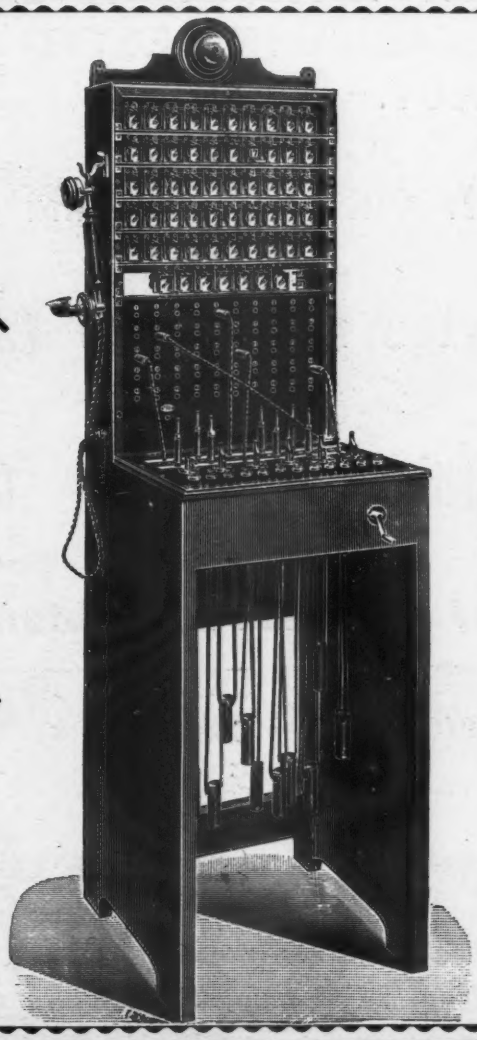

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ENCLOSED MOTORS

CONTINUOUS CURRENT.

Fitted with

SELF-OILING BEARINGS.

CARBON BRUSHES.

DRUM-WOUND ARMATURES.

CAST STEEL MAGNETS.

Advantages—

THEY WILL RUN WITHOUT ATTENTION.

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Write for Price List.

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Electrical Measuring Instruments.

ELECTROMAGNETIC—Gravity Control.
For Continuous and Alternating Current,

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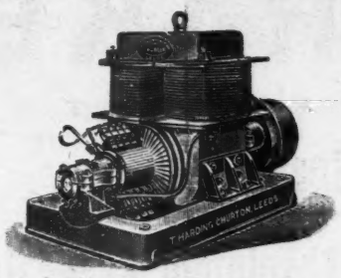

72 KW. DYNAMO, 500 REVS.

DYNAMOS

Open and Enclosed

MOTORS

for all purposes.

NO SPARKING.

SELF-OILING.

HIGHEST EFFICIENCY.

SEND FOR PRICE LISTS. 44m

STREET LIGHTING WITH INCANDESCENT LAMPS.

FRÉDUREAU'S Patent Projector.

As recently adopted in

CANTERBURY,

BOOTLE,

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ADVANTAGES:—

1.—Perfect distribution of light.
2.—Once fitted requires no further attention.
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Can be adapted to suit local requirements.

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Quotations and Particulars on application.

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SWITCHBOARDS.

N.C.S.
TESTING BRAKE

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Perfectly Simple to use,

Absolutely Accurate.

No Soap and Water, or other Lubricant Required.

Gives Instantaneous Readings.

PRICE, COMPLETE, £10 10s.

Special List of Station Engineers' and Contractors' Instruments sent on application.

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The CAMBRIDGE ELECTRIC SUPPLY CO., Ltd.,
Thompson's Lane, Cambridge, May 5th, 1897.

Messrs. MELDRUM BROS., MANCHESTER.

YOUR FURNACES.

Dear Sirs,—At the end of the month's trial, April 30th, you will be glad to hear that your furnace has fulfilled the guarantee: the amount per unit generated in coal has been reduced by **17½ per cent.**, and per unit sold **30 per cent.**

THE ABSENCE OF SMOKE IS VERY MARKED, excepting a slight amount when the boiler has been forced hard: we have on several occasions obtained an evaporation of over **8,000 lbs.** per hour (boiler being two-flue Lancs., 30 feet by 7 feet 6 inches).

There is little doubt that the Board at their next meeting will decide to add these Furnaces to the two remaining boilers.

(Signed), JOHN H. BARKER.

NOTE.—Since the above letter was written we have received the order for the two remaining boilers.

J. P. HALL & CO., OLDHAM.

MAKERS OF

DYNAMOS, MOTORS.

Telegrams: DYNAMO
Telephone No. 300. } OLDHAM.

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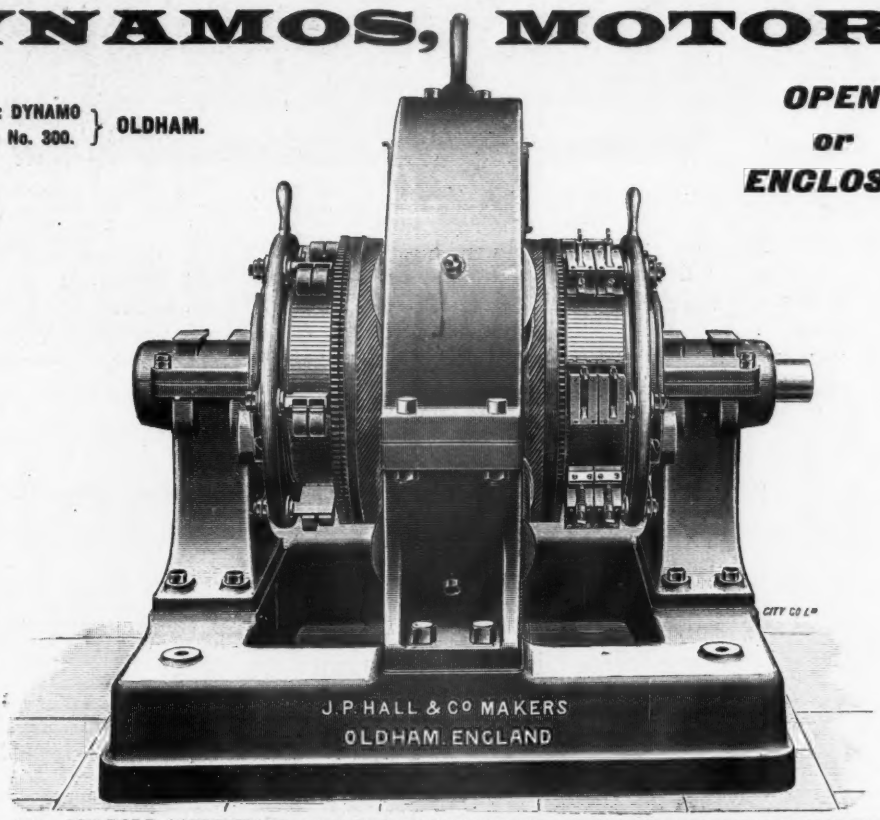

Fig. 148.—SIX-POLE CONTINUOUS CURRENT TRANSFORMER WITH SLOTTED DRUM ARMATURE. 117

ENGINES and BOILERS supplied and fixed with all Accessories.
FEED WATER HEATERS, CONDENSERS & COOLING PLANT.
STEEL and COPPER STEAM PIPES and Bends, &c.
VALVES and EXPANSION JOINTS, &c.,
SHAFTING, PULLEYS, &c.,
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Established 1855.
Write for Estimates.

HIGH-SPEED
AIR COMPRESSORS,
for all Pressures up
to 200 lbs. per Square Inch,
For AIR BRAKES, MINES, &c.,
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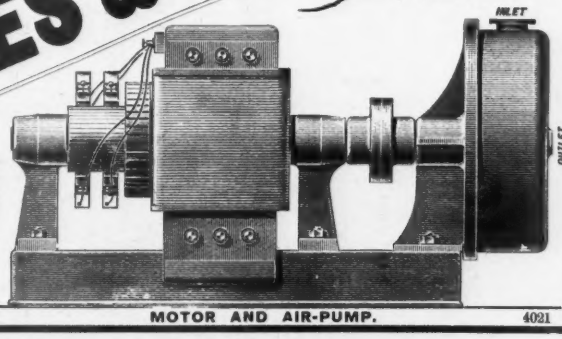

MOTOR AND AIR-PUMP. 4021

ORIGINATORS. J. D. F. ANDREWS & CO., Ltd. PIONEERS.

CONCENTRIC WIRING.

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Manufacturers of Electrical Wires of every description for Electrical Instruments, Dynamos, Machines, Telephones, and Electric Bells.

INSULATED LINE WIRES AND CABLES.

IMPROVED ELECTRIC WIRING.

☛ ***The Insulating Lining*** guarantees a Smooth Frictionless Interior Surface, so that wires ***cannot*** be abraded, and are at the same time easily accessible. This lining of definite thickness (not a mere film) is "Arc Proof," whereas ordinary metallic piping can be "burnt out," and is therefore ***not electrically*** "fire-proof." The minimum thickness of steel has been adopted which can be guaranteed "nail proof" in ordinary building construction, under floors, &c. This Insulating Lined Steel Pipe can be ***readily bent*** or "set" cold.

"THE BEST." STEEL ARMOURED INSULATING CONDUIT. "THE BEST."

Only "screw thread" sockets ***can ensure*** a mechanically strong and watertight pipe-way, but our special thread effects a ***great saving*** in time and labour of jointing. This insulating lining ***does not condense*** internal moisture, and prevents the "rusting" and electrolytic and chemical action incidental to ordinary metallic pipes. It also presents a ***permanent insulation*** which will stand by your Electrical Conductors under all conditions. "The Certainty" of wiring work carried out with Steel Armoured Insulating Conduit makes it the Standard for ***high-class construction.*** The ***C. & I. Co.*** offer a Complete System of wiring in Steel Armoured Insulating Conduit applicable either to earthed-outer, two or three-wire methods of distribution.

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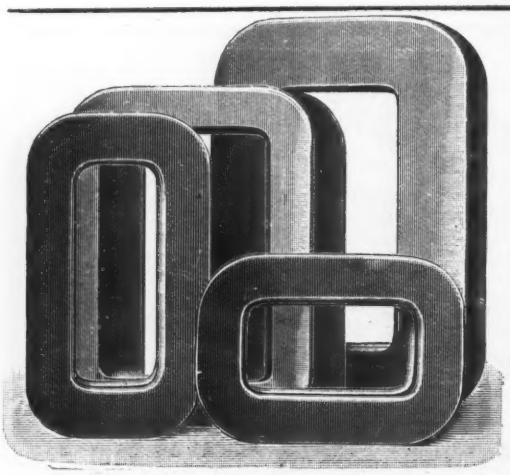

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GEBRÜDER ADT,

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Manufacturers of Electrical Isolating Materials, viz.:

ISOLATING CONDUIT-TUBES WITH and WITHOUT METALLIC COVERS, to enclose electrical conducting wires, elbows, corner pieces, as well as alidings, for the complete installation of electrical conduit tubes; further, PROTECTING BOXES, DERIVATION BOXES, and JUNCTION BOXES of every description.

INSULATED CASES for Dynamos Motors and Transformers.

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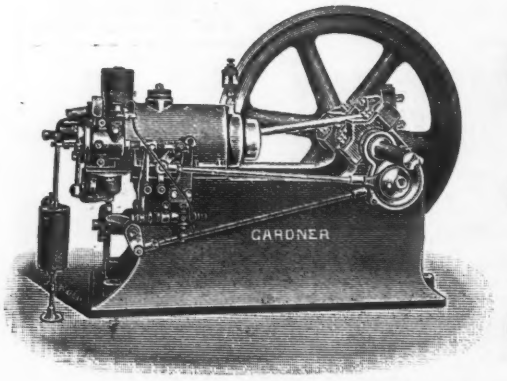

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OIL ENGINES, GAS ENGINES, PETROLEUM SPIRIT (BENZOLINE) ENGINES. DYNAMOS, COMBINATIONS OF ENGINES AND DYNAMOS.

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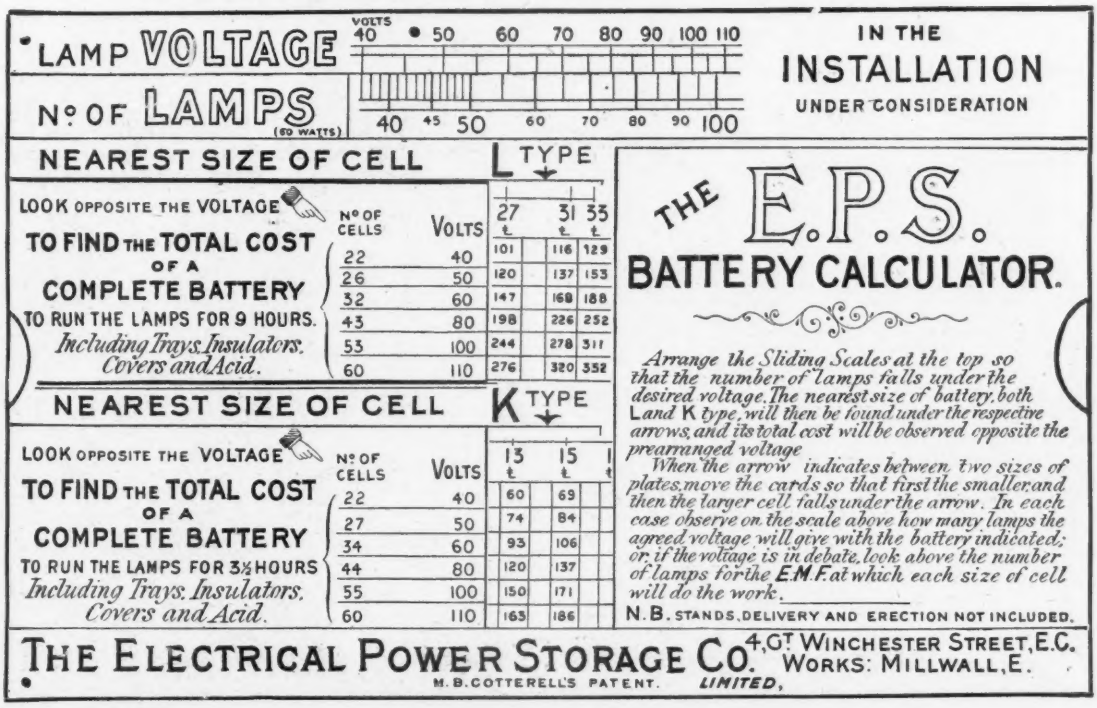
Whereby Batteries can be priced AT A GLANCE for ALL OUTPUTS and VOLTAGES from 15 Lamps at 40 volts to 300 kilowatts at 220 volts.


LAMP VOLTAGE
VOLTS 40 50 60 70 80 90 100 110
Nº OF LAMPS (60 WATTS)
40 45 50 60 70 80 90 100
IN THE INSTALLATION UNDER CONSIDERATION
NEAREST SIZE OF CELL
L TYPE
LOOK OPPOSITE THE VOLTAGE
TO FIND THE TOTAL COST OF A COMPLETE BATTERY TO RUN THE LAMPS FOR 9 HOURS.
Including Trays, Insulators, Covers and Acid.
Nº OF CELLS
VOLTS
27 £ 31 £ 33 £
22 40 101 116 129
26 50 120 137 153
32 60 147 168 188
43 80 198 226 252
53 100 244 278 311
60 110 276 320 352
NEAREST SIZE OF CELL
K TYPE
LOOK OPPOSITE THE VOLTAGE
TO FIND THE TOTAL COST OF A COMPLETE BATTERY TO RUN THE LAMPS FOR 3½ HOURS
Including Trays, Insulators, Covers and Acid.
Nº OF CELLS
VOLTS
13 £ 15 £
22 40 60 69
27 50 74 84
34 60 93 106
44 80 120 137
55 100 150 171
60 110 163 186
THE E.P.S. BATTERY CALCULATOR.
Arrange the Sliding Scales at the top so that the number of lamps falls under the desired voltage. The nearest size of battery, both L and K type, will then be found under the respective arrows, and its total cost will be observed opposite the prearranged voltage.
When the arrow indicates between two sizes of plates, move the cards so that first the smaller and then the larger cell falls under the arrow. In each case observe on the scale above how many lamps the agreed voltage will give with the battery indicated; or, if the voltage is in debate, look above the number of lamps for the E.M.F. at which each size of cell will do the work.
N.B. STANDS, DELIVERY AND ERECTION NOT INCLUDED.
THE ELECTRICAL POWER STORAGE CO. LIMITED, 4, GT WINCHESTER STREET, E.C. WORKS: MILLWALL, E.
M.B. COTTERELL'S PATENT.

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Works:—MILLWALL, E.

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ELECTRICAL & TELEGRAPH ENGINEERS.

Manufacturers of Telegraph and Electrical Instruments, Iron Poles, Insulators, Electric Mine Exploders, Torpedoes, Torpedo Apparatus, Police, Fire, and Railway Signals, and Block Apparatus.

BATTERIES OF ALL TYPES.

Dynamos and Alternators, Motors, Transformers, Arc Lamps, Ammeters, and Voltmeters.

INDIA-RUBBER, GUTTA-PERCHA LEAD COVERED AND IRON SHEATHED

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FOR TELEGRAPH TELEPHONE AND OTHER ELECTRICAL PURPOSES.

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Large Stocks of Cables and Wires for Electric Lighting kept for immediate delivery; also Stocks of Pure Rubber Strip, Insulating Tape, India-rubber Solution, and of all Accessories for jointing purposes.

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Works—WOOLWICH, KENT.

Telegrams: "SIEMENS, LONDON." *Codes: A B C, A 1 ENGINEERING, MOREING & MacCUTCHEON'S.* 674

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Part of NEW WORKS. Water Wheels of 150 H.P. Condensing Engine 140 H.P.

D.P.

The unparalleled success of the D.P. Battery has brought a number of imitations into the market.

Purchasers should see that they get the D.P. Cells installed, as used at Chatsworth, Wynyard Park, Bank of England, &c., and should not be put off with any of the newer batteries which have not stood the test of time.

Many of the above cells have been in use for seven years without repairs, and have then required positives alone, representing a maintenance cost of 4½ per cent. per annum.

The D.P. BATTERY CO., Ltd.,

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Telegrams:—"ACCUMULATOR, LONDON." Telephone:—71, Westminster.

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EVERED & CO., Ltd.,

LONDON and BIRMINGHAM.

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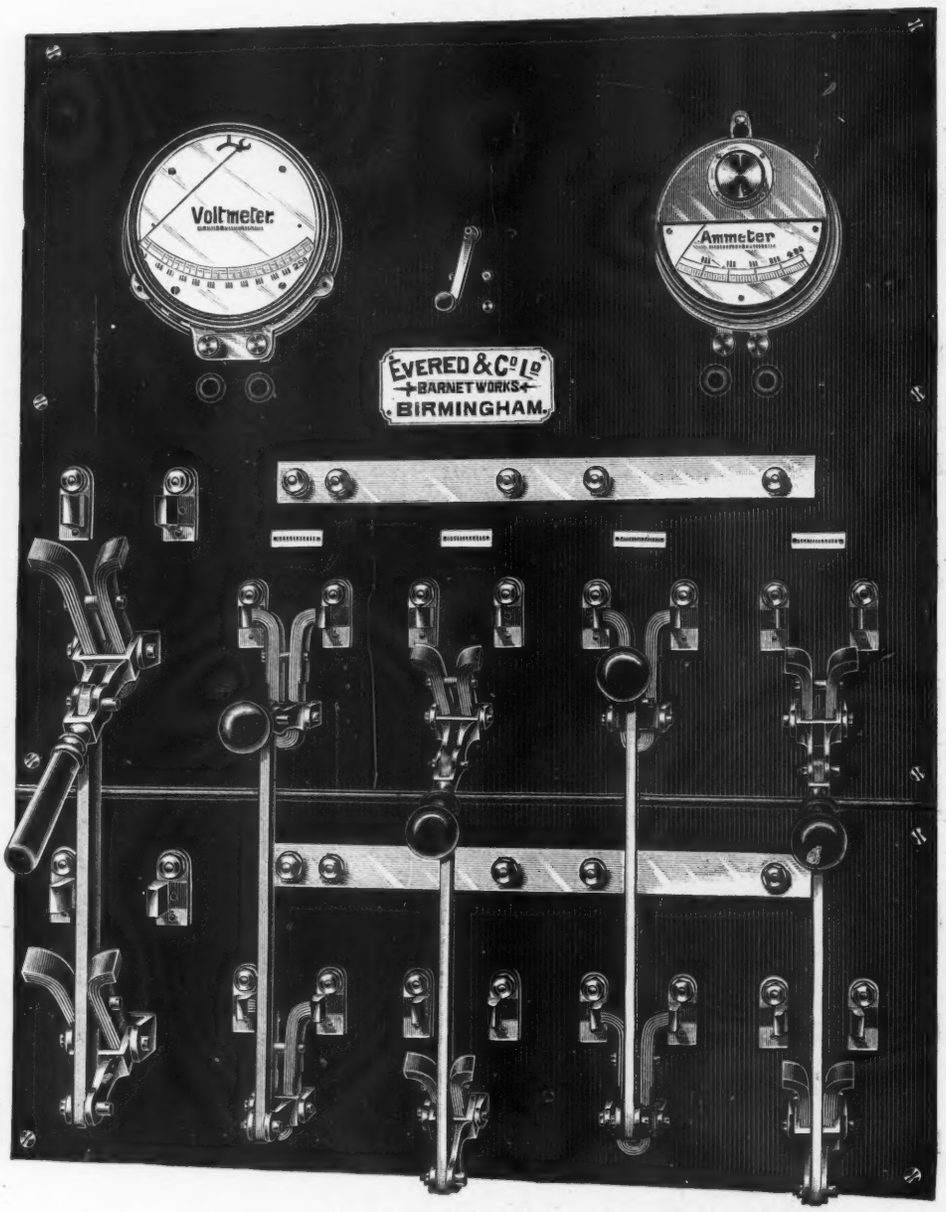

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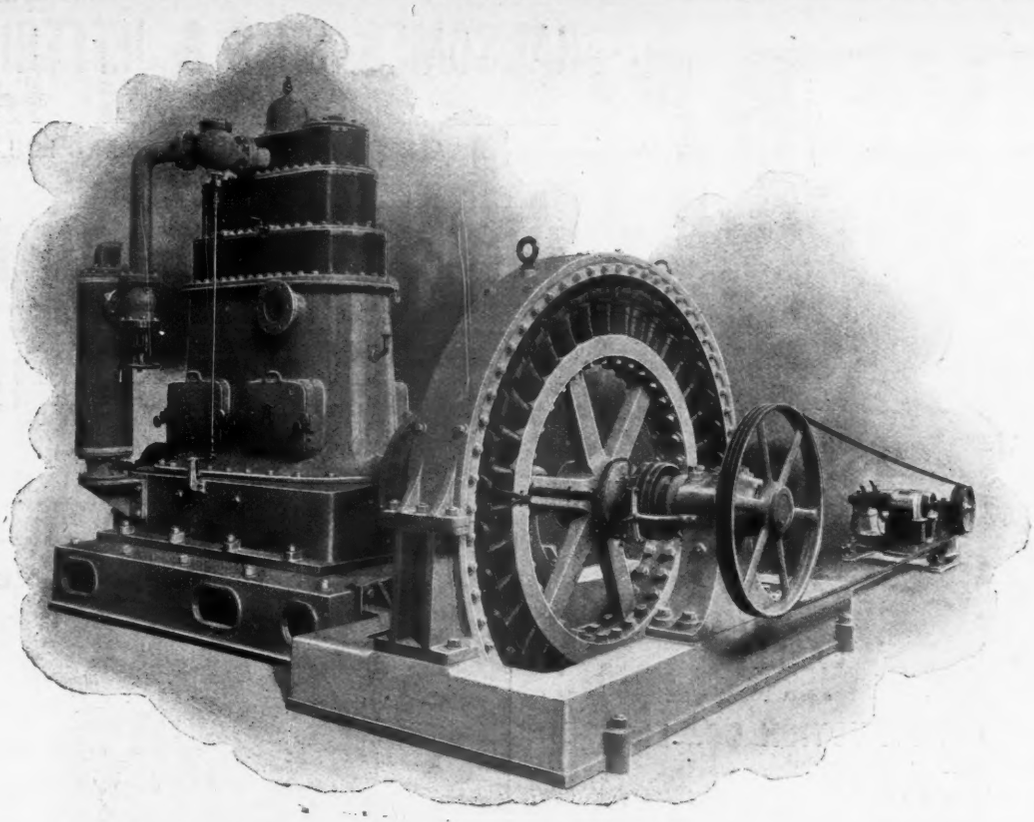

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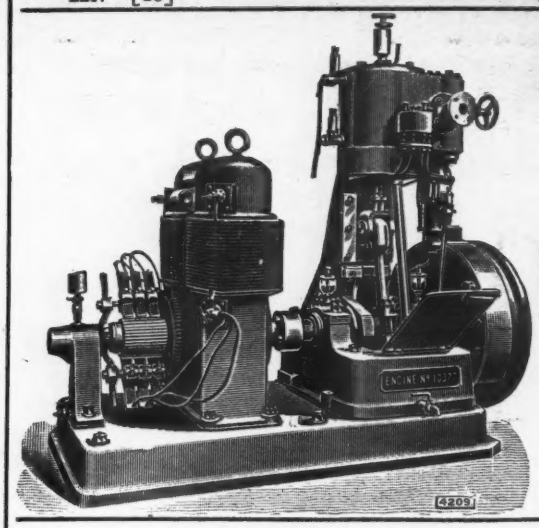

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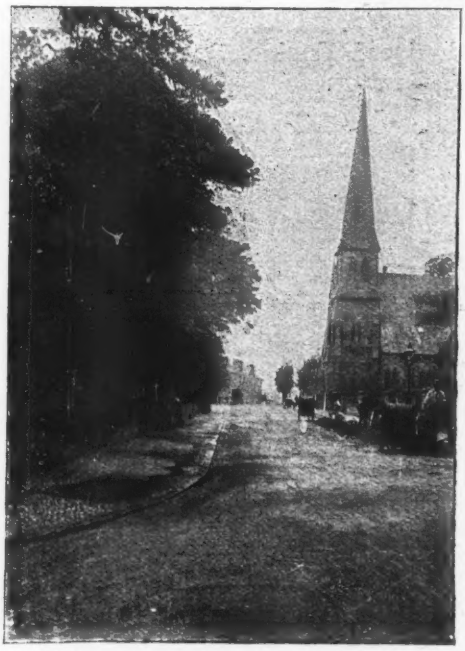

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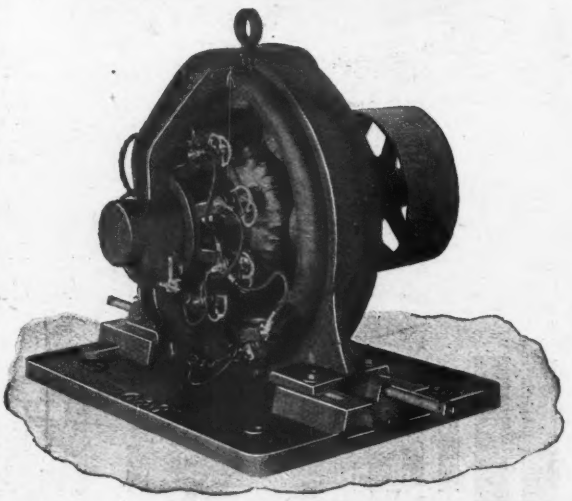

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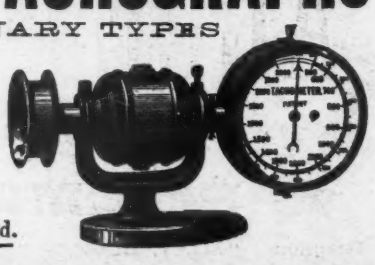

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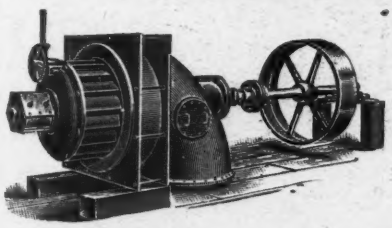

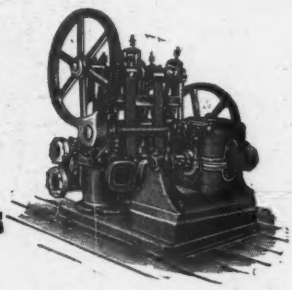

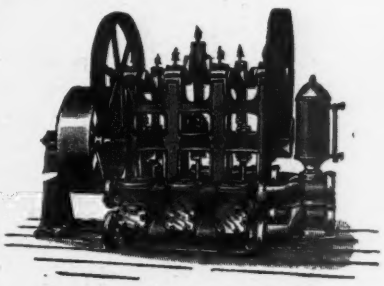

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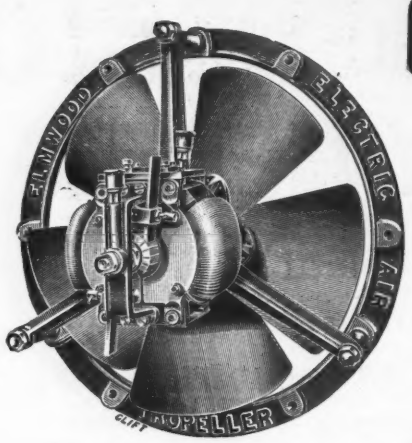

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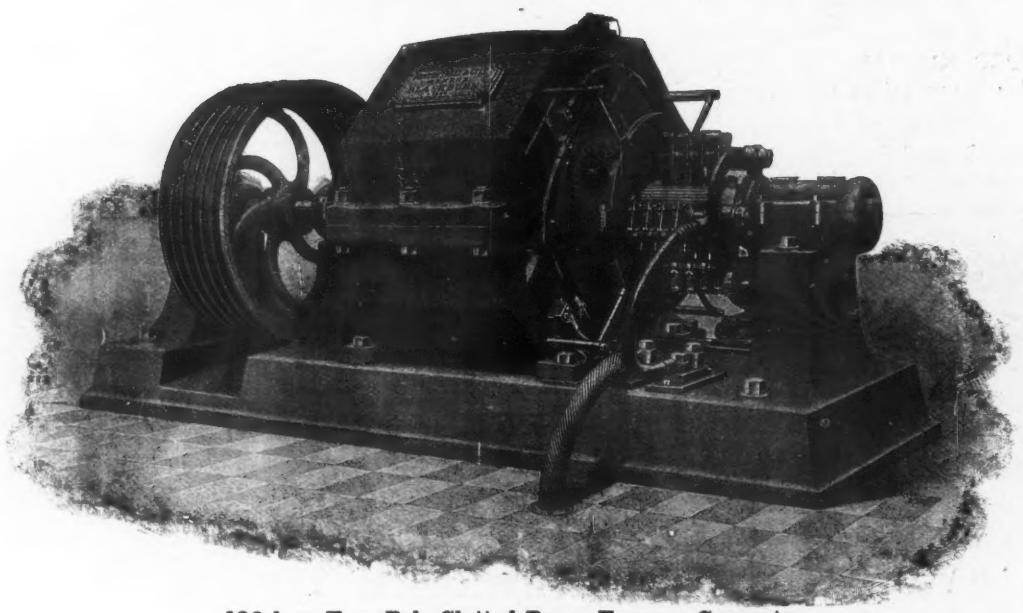

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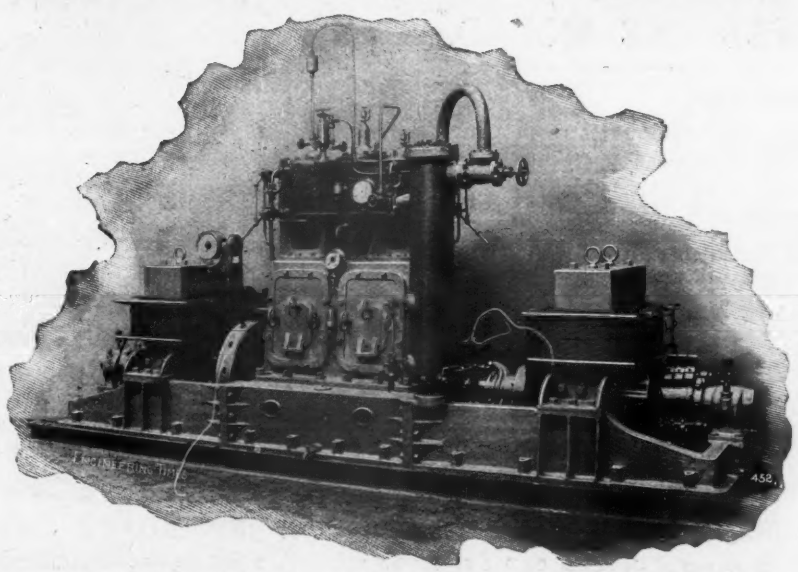

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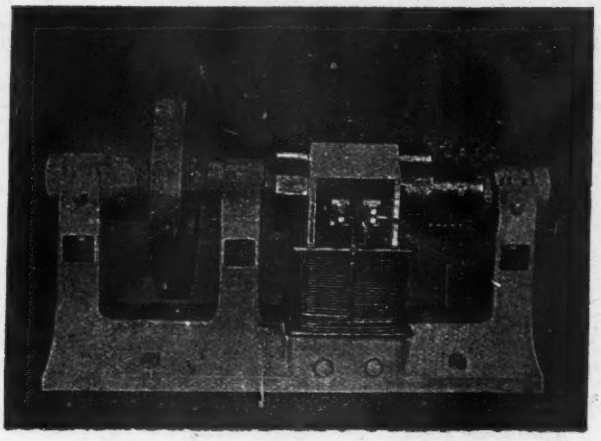

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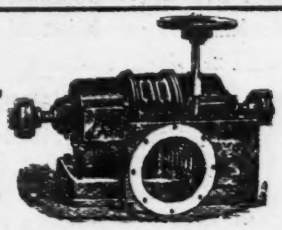

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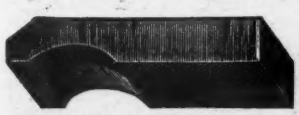

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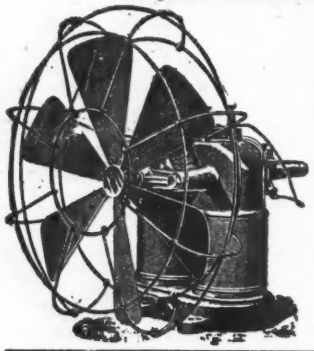

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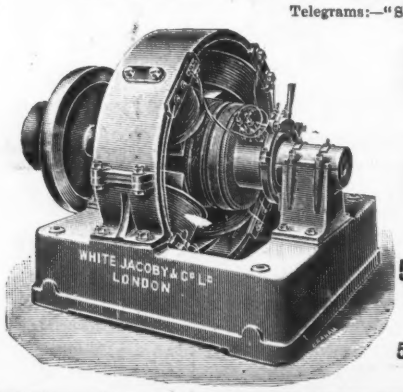

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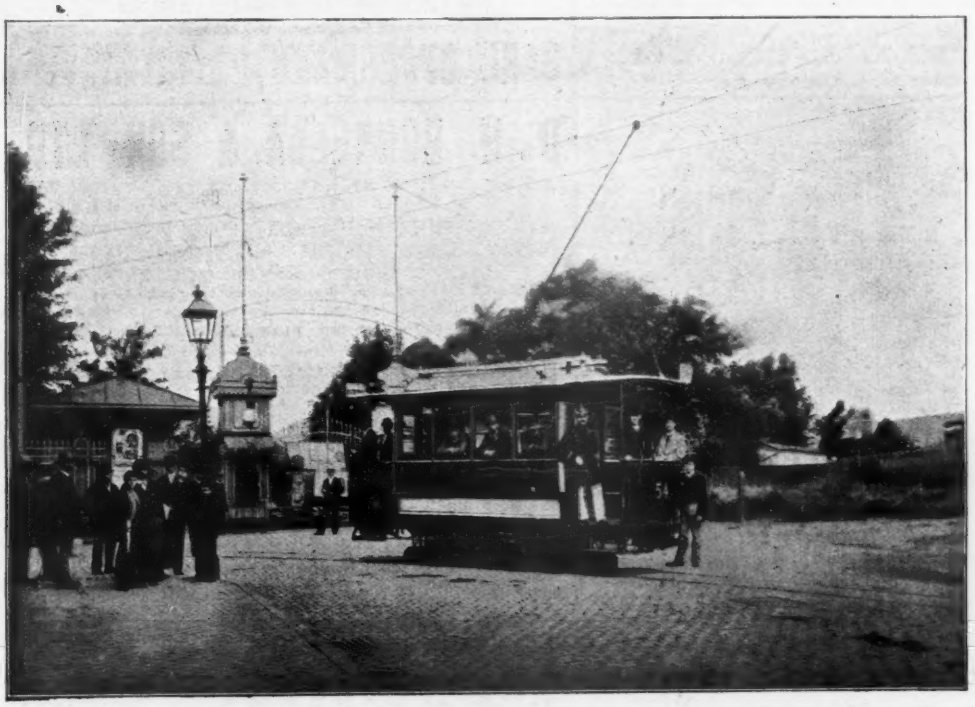

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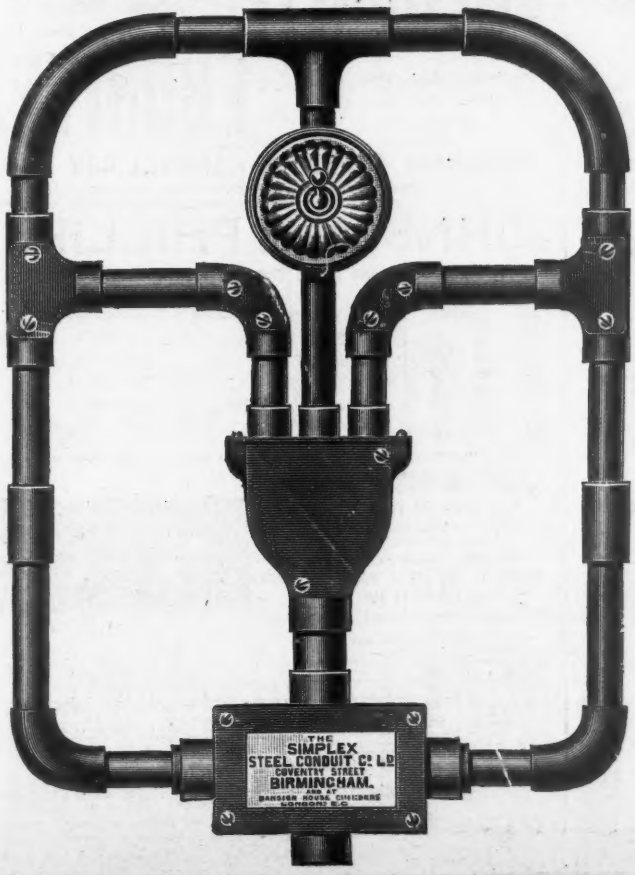

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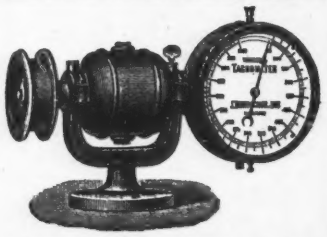

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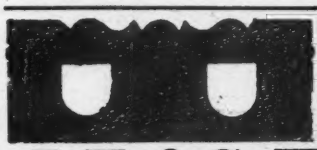

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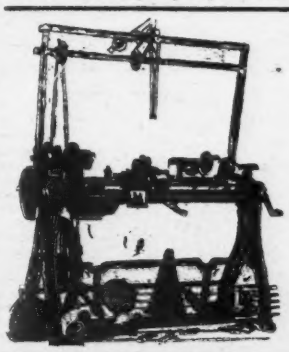

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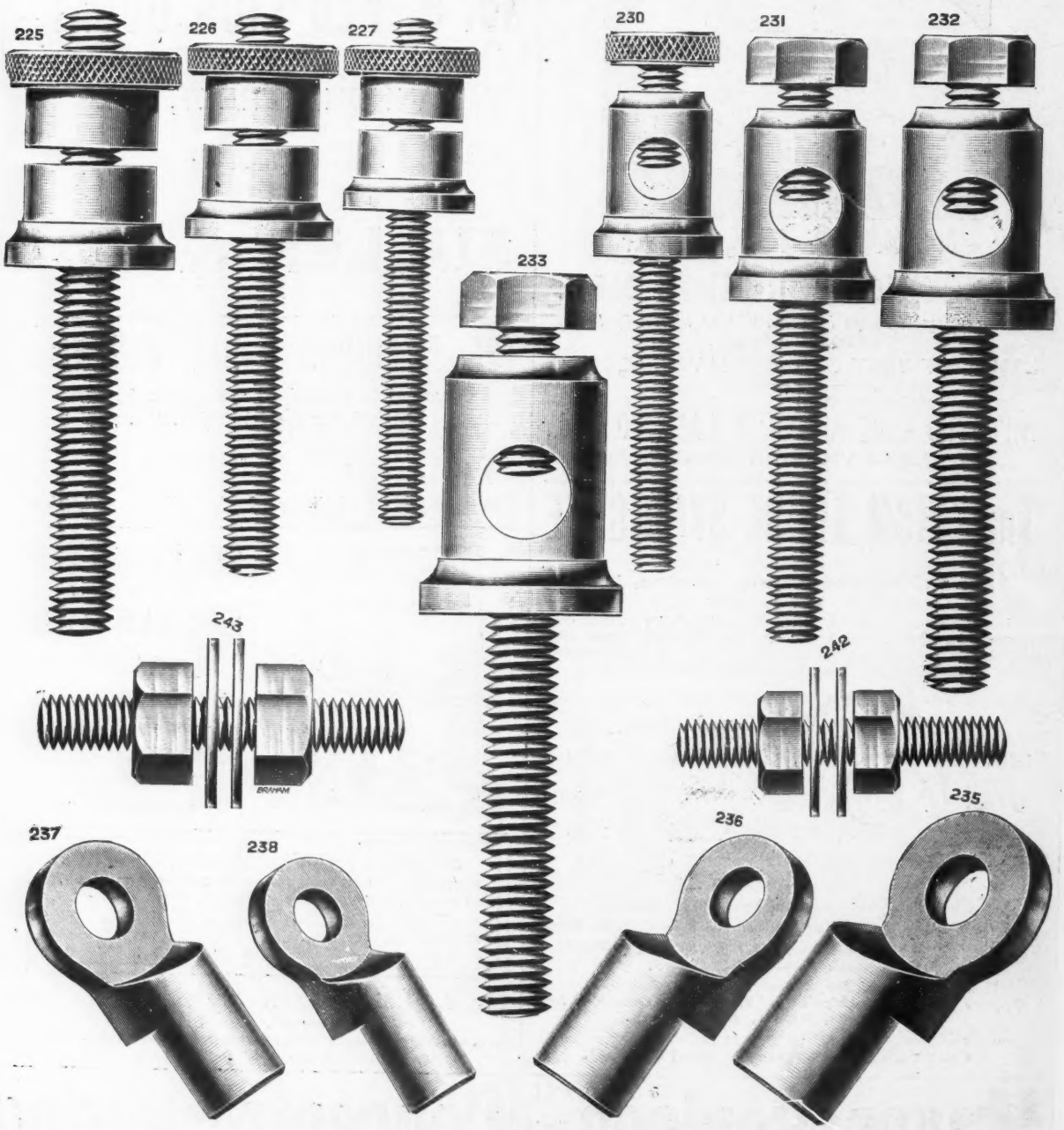

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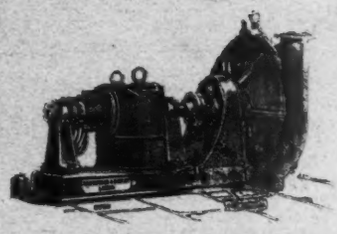

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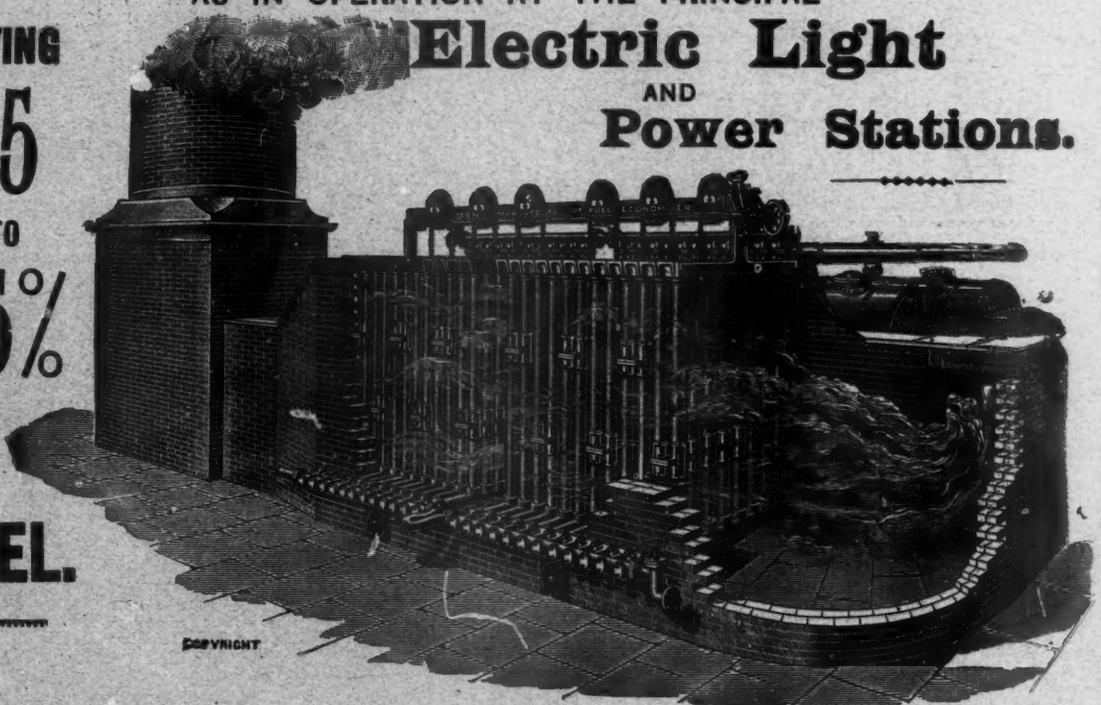

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